

WASTEWATER RECLAMATION PILOT STUDY CITY OF McALLEN, TEXAS

Water Treatment Technology Program Report No. 26

April 1998

U.S. DEPARTMENT OF THE INTERIOR Bureau of Reclamation Technical Service Center Environmental Resources Team Water Treatment Engineering and Research Group

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by

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ACRONYMS AND ABBREVIATIONS

BOD,	biochemical oxygen demand
CBOD,	carbonaceous biochemical oxygen demand
DBP	disinfection byproducts
DDE	disinfected, dechlorinated effluent
DO	dissolved oxygen
EPA	Environmental Protection Agency
ft^2	square foot
gfd	gallons per square feet per day
gpm	gallons per minute
HAA	haloacetic acid
HRT	hydraulic retention time
IPR	5
	indirect potable reuse
L/s	liters per second
m²	square meter
MCL	maximum contaminant level
MF	microfiltration
mg/L	milligrams per liter
•	million gallons per day
mgd	
ML	million liters
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
O&M	operations and maintenance
OUR	oxygen uptake rate
PLC	programmable logic controller
ppm	parts per million
psig	pounds per square inch gauge
RAS	return activated sludge
RO	reverse osmosis
SDI	silt density index
SDS	simulated distribution system
SO ₂	sulphur dioxide
-	-
SRT	solids retention time
SWWTP	South Wastewater Treatment Plant
TDS	Total dissolved solids
THM	trihalomethane
TMP	transmembrane pressure
TNRCC	Texas Natural Resources Conservation Commission
TSS	total suspended solids
TWDB	Texas Water Development Board
	-
UOSA	Upper Occoquan Sewage Authority
W	ultraviolet
μg/L	micrograms per liter
$\mu { m m}$	microns
WAS	waste activated sludge
WWTP	wastewater treatment plant

1. INTRODUCTION AND BACKGROUND

This report documents a wastewater reclamation pilot study performed at the McAllen, Texas, wastewater treatment plant (WWTP) No. 2. The study was conducted under Task 9: Membrane Separation Process for Wastewater Reclamation of the U.S. Bureau of Reclamation's Water Treatment Technology Program. Testing was conducted from April 1997 to August 1997. The purpose of this study was to evaluate the capability of the Memcor microfiltration (MF) membrane technology and the ZeeWeed MF membrane technology to treat wastewater for indirect potable reuse to supplement the City of McAllen's water supply.

The Memcor and the ZeeWeed MF units were evaluated while treating secondary effluent from the McAllen WWTP. The ZeeWeed MF system was also evaluated when used in conjunction with the ZenoGem process to treat screened, de-gritted wastewater and make it suitable for direct processing by reverse osmosis (RO). The ZenoGem process is designed to biologically treat screened, de-gritted sewage and microfilter the "secondary effluent" that is produced.

This section defines indirect potable reuse and its history in the U.S., defines the City of **McAllen's** motivations for considering implementation of indirect potable reuse to help solve their water supply problems, describes the regulatory issues associated with implementation, explains the reasons membrane processes are integral to its implementation, and presents conclusions and recommendations.

1.1 Indirect Potable Reuse-Definition and History

Indirect potable reuse (IPR) is the recovery of water from wastewater for the purposeful reintroduction into either a surface water or groundwater body that ultimately serves as a drinking water supply. Unplanned IPR has been occurring since humans first began disposing of wastewaters into watersheds that are hydrologically connected to raw water supplies. Planned IPR began in the U.S. in the 1960s. A summary of some of the major milestones in the development of potable reuse as a viable component of a water resource management plan is presented below.

Whittier Narrows Groundwater Replenishment Project, California. In 1962, the County Sanitation Districts of Los Angeles began spreading disinfected secondary effluent from a 10-million-gallons-per-day (mgd) (37.9 million liters [ML]/day) water reclamation plant to an underground potable water supply. The reclaimed water accounts for an annual average of 16 percent of the total inflow to the groundwater basin. The local population is estimated to be exposed to from 0 to 23 percent reclaimed water. An independent, scientific advisory panel to the State of California conducted an extensive review of the project data and concluded that the Whittier Narrows Groundwater Replenishment Project was as safe as commonly used surface water supplies.

Orange County, California, Water District. Since 1976, the Orange County, California, Water District's Water Factory 21 has been reclaiming **unchlorinated** secondary effluent to drinking water quality and recharging it into a heavily used groundwater source to prevent salt water intrusion. The water recovery treatment facility is a **15-mgd** (56.8 ML/day) facility that includes lime clarification, air stripping, recarbonation, filtration, carbon adsorption, slip-stream RO, and disinfection. It is estimated that less than 5 percent of the domestic water supply is recovered water. The Orange County Water District has not identified any significant risk to users of the groundwater from the indirect potable reuse practice.

Upper Occoquan Sewage Authority Water Reclamation Plant, Virginia. In 1978, the **15-mgd** Upper Occoquan Sewage Authority (**UOSA**) Water Reclamation Plant in northern Virginia began reclaiming wastewater for subsequent discharge to the Occoquan Reservoir. This reservoir is a critical source of drinking water for approximately 1 million people. The reclaimed water has accounted for as much as 90 percent of the flow into the reservoir. Treatment includes primary treatment, secondary treatment, biological **nitrification**, lime clarification and recarbonation, filtration, **activated** carbon adsorption, and disinfection. The plant has been expanded to 26 mgd (98.4 ML/day) and will be further expanded to 54 mgd (204 **ML/day**) by the year 2000. No negative health effects have been attributed **to the** plant or **effluent** discharges.

Potomac Estuary Experimental Water Treatment Plant, Washington, D.C. From 1981 to 1983, the l-mgd (3.8 ML/day) Potomac Estuary Experimental Water Treatment Plant was operated with an **influent** blend of Potomac Estuary water and **nitrified** secondary effluent. The blend was designed to simulate **influent** water quality expected during drought conditions, when up to 50 percent of the estuary flow may comprise treated wastewater. Treatment included aeration, coagulation, clarification, **predisinfection**, filtration, carbon adsorption, and postdisinfection. An independent panel reviewed the extensive testing performed by the U.S. Army Corps of Engineers and concluded that the advanced treatment could **recover** water from a highly contaminated source similar in quality to three major water supplies for the Washington, D.C., metropolitan area.

San Diego Total Resource Recovery Project, California. In 1983, a l-mgd (3.8 ML/day) potable water recovery demonstration facility was commissioned as part of a total resource recovery program established in San Diego, California. The purpose of the treatment system was to reclaim raw water from raw wastewater. The system included primary treatment, a water hyacinth aquaculture system, coagulation, clarification, filtration, ultraviolet disinfection, reverse osmosis, aeration, carbon adsorption, and disinfection. An extensive chronic toxicity risk analysis showed that the risk associated with use of the recovered water as a raw water supply was less than or equal to the use of the existing raw water entering the City's Miramar Water Treatment Plant. The City is now planning on reclaiming up to 20 mgd (75.7 ML/day) of secondary effluent for augmentation of their 90,000 acre-foot San Vicente Reservoir for eventual distribution to water customers.

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El Paso, Texas, Fred Hervey Water Reclamation Plant. The 10-mgd (37.9 ML/day) Fred Hervey Water Reclamation Plant began operation in El Paso, Texas in 1985. The recovered water is recharged to the Hueco Bolson drinking water aquifer where, over a Z-year period, the water travels to one of El Paso's potable water well fields to become part of the potable water supply. The treatment system includes primary treatment, activated sludge/ powdered activated carbon treatment, lime treatment, recarbonation, filtration, ozonation, and granular activated carbon adsorption. Although no negative health effects have been correlated with the reuse practice, an increase in the total dissolved solids (TDS) content of the aquifer has occurred. Slipstream demineralization will be included in future plant expansions to address the TDS issue.

Tampa Water Resource Recovery Project, Florida. The City of Tampa's Water Resource Recovery Pilot Plan began operation in 1986, with the purpose of evaluating the feasibility of reclaiming **denitrified** secondary effluent to a quality suitable for blending with existing surface water and groundwater sources for indirect potable reuse. Several treatments were evaluated, and one was selected for health effects testing. This treatment system consisted of aeration, high **pH** lime clarification, recarbonation, filtration, granular activated carbon adsorption, and ozonation. The results of the health effects testing, coupled with the microbiological and chemical analyses performed during the evaluation, indicated that the quality of the reuse water was equivalent to or exceeded the quality of the local raw water supply. The City of Tampa intends to develop a **20-** to **50-mgd** (189 **ML/day**) water resource recovery plan in the near future.

West Basin Water Recycling Program, California. From 1990 through 1995, the West Basin Municipal Water District conceived, designed, constructed, and began operating the West Basin Water Recycling Program. This program includes reclaiming 5 mgd (18.9 **ML/day**) (expandable to 20 mgd, or 75.7 ML/day) of secondary effluent from the City of Los Angeles's Hyperion Treatment Plant for injection into the West Coast Basin Barrier Project. The West Coast Basin Barrier Project has historically received an average of 20 mgd of potable water for injection into the coastal reaches of local south Bay aquifers for mitigation of saltwater intrusion. Substituting reclaimed water for the potable water provides substantially greater water use efficiency in the area. Reclamation treatment includes predecarbonation, lime clarification, recarbonation, filtration, RO, postdecarbonation, and final disinfection. Based on hydrogeologic investigation and modeling of the West Coast Basin, it is anticipated that the reclaimed water will improve groundwater quality along the Barrier due to the high quality of the reclaimed water relative to the imported water and the native groundwater.

Reedy Creek Improvement District, Advanced Water Reclamation Program, Florida. In 1992, **the Reedy** Creek Improvement District began a pilot program to reduce phosphorus and nitrogen in the effluent from their wastewater treatment plant to very low levels. Although the goal of treatment was not IPR, this was the first project to **evaluate** the feasibility of using microfiltration and ultrafiltration (**UF**) as a pretreatment. This approach was shown to be so effective that **MF** and UF have displaced lime treatment as the preferred means of RO pretreatment on subsequent IPR projects.

City of Scottsdale, Arizona, Water Campus Project. In 1994, the City of Scottsdale began pilot testing MF and RO for the purpose of reclaiming wastewater for **ground**-water recharge. The testing program, which has culminated in a 6.3mgd (25.7 ML/day) indirect potable reuse project currently under construction at the City's Water Campus site, represents the first planned IPR project in Arizona. During periods when demand for non-potable reclaimed water is low, product water from the MF/RO system will be blended with filtered surface water and injected into a potable aquifer using dry wells. The 6.3mgd facility represents the first phase of a multi-year project designated to have an ultimate capacity of 25 mgd (94.6 ML/day).

City of San Diego, California, Water Repurification Project. As an outgrowth of their Total Resource Recovery Project, the City of San Diego began the Repurification Project to reclaim up to 20 mgd (75.7 ML/day) of wastewater for indirect potable use. The program is currently evaluating the feasibility of using the following advanced water treatment processes tore-purify tertiary effluent from the City's new North City Water Reclamation Plant to a quality suitable for direct discharge to the San Vicente Reservoir, one of the City's main raw water reservoirs: microfiltration/ultrafiltration, reverse osmosis, ion exchange, and ozonation. The project represents the first surface supply augmentation IPR project in California and must satisfy stringent California Department of Health Services requirements regarding virus removal and real-time monitoring of individual processes for pathogen removal. If successful, the project will result in the construction of the largest IPR plant in the U.S.

1.2 The Need for Indirect Potable Reuse for the City of McAllen

McAllen, Texas, is located in the Lower Rio Grande Valley near the United **States**-Mexico border, approximately 40 miles upstream from the mouth of the Rio **Grande** River. McAllen presently derives its water supply from the Rio Grande River, water rights it shares with multiple parties, including other cities, water supply corporations, irrigation districts, and Mexico. The Lower Rio Grande Valley is a growing area with an existing water shortage problem. The Texas Water Development Board (TWDB) reports that all surface water resources in the area are 100 percent appropriated. Additionally, this semi-arid area often experiences drought conditions. Projected growth in population and water use indicates that the demand for potable water will exceed **McAllen's** authorized water rights by the year 2003. Consequently, alternative water supply strategies are necessary to ensure a safe, reliable source of potable water. The two most feasible alternative sources are groundwater and re-purified wastewater. Many of the groundwater supplies in the Lower Rio Grande Valley have an elevated dissolved solids concentration and require demineralization to make them suitable for potable use. Consequently, wastewater reclamation is considered by McAllen to be a desirable means of augmenting its water supply.

1.3 Water Quality Considerations and Proposed Treatment Strategy

In general, reclaimed water should be treated to a level where its quality exceeds that of the historical water supply. In Texas, public heath issues related to the use of reclaimed water fall under the purview of the Texas Natural Resources Conservation Commission (TNRCC). The preliminary position of TNRCC with respect to IPR for McAllen is (1) reclaimed water must be of equal or better quality than that of the City's current water supply, and (2) reverse osmosis must be used to treat all of the reclaimed water prior to its reuse. Based on these requirements and in view of the City's desire to reduce the dissolved solids of its finished water to improve consumer acceptability, the following IPR treatment sequence is currently proposed:

> Primary and secondary treatment Chlorine disinfection Microfiltration Reverse osmosis Ultraviolet disinfection

This sequence not only satisfies **TNRCC's** preliminary requirements, it also provides multiple treatment barriers to the passage of microbial, inorganic, and organic contaminants in the wastewater. The concept of "multiple barriers" has been adopted by the water supply industry to achieve the appropriate level of safety and reliability by providing redundant treatment steps for the removal of wastewater contaminants, primarily pathogens.

1.4 Membrane Technologies in indirect Potable Reuse

A primary focus of one task of the Bureau of Reclamation's Water Treatment Technology Program is research on membrane processes for wastewater reclamation. A key component of the proposed treatment sequence for IPR at McAllen includes the use of two membrane processes, MF and RO. As described in Section 1.2, RO has been applied for two decades for wastewater reclamation and is considered a proven treatment process. RO serves as the "workhorse" for the IPR process because it is very efficient in removing nearly all contaminants of public health concern. Cost-effective RO operation is highly dependent on the quality of water it receives, and a major challenge of its use in treating wastewaters is to provide a suitable quality feedwater. In this context, MF has become an important process. Although MF has been used for industrial and pharmaceutical applications for decades, its use for wastewater reclamation is relatively new, and to date, most research with MF has been conducted with only one technology, the Memcor MF process. Memcor has been pilot testing for over 5 years; however, full-scale operations are limited and have been installed only very recently in California. Further, evaluation of technologies competitive to Memcor, including those employing MF and its close relative UF, is in its infancy and is currently restricted to only one or two sites. Thus, research is needed to evaluate Memcor at other IPR sites throughout the U.S. to demonstrate its applicability over a wider geographic area and, more importantly, to examine the feasibility of other **MF/UF** technologies that have equivalent or better capability to meet the feedwater requirements of RO.

One such MF technology is ZeeWeed. ZeeWeed is a relatively new process and no studies on its application to IPR have been reported. Memcor and ZeeWeed were selected for evaluation in this study to develop a cost-effective technical approach to **implementing** IPR for **McAllen** and to contribute vital information on the application of MF technologies for wastewater reclamation. Additionally, the ZeeWeed MF system was evaluated when used in conjunction with the **ZenoGem** process for treating screened, degritted wastewater.

1.5 Conclusions

Overall project conclusions were developed as well as specific conclusions relating to each phase of study. These conclusions are presented below.

1.5.1 Project Conclusions

The following can be concluded from the results of this study:

- 1. Both **microfiltration (MF)** technologies evaluated in this study, Memcor and ZeeWeed, are applicable to the advanced treatment of City of **McAllen** wastewater for the purpose of indirect potable reuse.
- 2. The Memcor MF process can efficiently treat secondary effluent from the **McAllen** South WWTP (SWWTP) for the purpose of producing high quality RO feedwater. Operating over an **18-week** period, Memcor filtrate turbidity and silt density index (**SDI**) averaged 0.10 **NTU** and 2.11, respectively, compared to RO industry recommendations for efficient operation of 0.2 **NTU** and 3. Filtrate quality and operating characteristics of the Memcor system treating this source are similar to those for the treatment of secondary effluents in California and Arizona. Memcor flux rate and feedwater recovery were sustainable at 27 gallons per square foot per day (gfd) (45.8 **L/m²/hr**) and 91 percent in this study compared to a range of 23 to 28 gfd (39.0 to 47.5 **L/m²/hour**) and 90 to 92 percent at reuse facilities in California. The estimated annual cost of Memcor MF and RO treatment for this application

(\$1.93 per 1,000 gallons of wastewater) is slightly less expensive than the cost of treating the secondary effluent with lime clarification, recarbonation, and filtration followed by RO (\$2.18 per 1,000 gallons of wastewater).

3. ZeeWeed MF technology is competitive with Memcor MF technology in the production of RO feedwater from secondary effluent when non-economic factors are considered. As shown below, ZeeWeed demonstrated a higher flux rate, greater feedwater recovery, and longer operating intervals between chemical cleanings than Memcor, while producing a filtrate of comparable quality.

	ZeeWeed	Memcor
Flux rate (gfd)	33.0	24.4
Feedwater recovery (%)	96.3	90.1
Interval between cleanings (davs)	>48	14

Table 1 .I-ZeeWeed and Memcor MF Operating Parameters

- The ZenoGem process is capable of directly processing screened and de-4. gritted raw wastewater to a quality that satisfies the City's current effluent discharge requirements of 15 milligrams per liter (mg/L) carbonaceous biochemical oxygen demand (CBOD₅) and 5 mg/L total suspended solids (TSS). The ZenoGem process is also capable of meeting the RO feedwater turbidity criterion of 0.2 NTU. ZenoGem filtrate averaged 0.6 mg/L CBOD, less than 1 mg/L TSS, and 0.16 NTU turbidity. Filtrate from the ZenoGem process was of lesser quality than filtrates produced by Memcor and ZeeWeed (treating secondary effluent) with respect to SDI. SDI tests averaged 5.0 for ZenoGem compared to 2.1 and 2.6 for Memcor and ZeeWeed, respectively, when treating filtered secondary effluent. The RO feedwater criteria for turbidity is 3.0 NTU. The high SDI values are not believed to be caused by greater particulate levels. Therefore, it is not known if RO operation on ZenoGem filtrate would result in a greater rate of membrane fouling.
- 5. ZenoGem can treat McAllen's raw wastewater to a quality comparable to the City's existing WWTP effluent more efficiently than the existing WWTP. By operating the activated sludge process at average mixed liquor volatile suspended solids (MLVSS) concentration of 11,000 mg/L and solids retention times of 3 to 5 hours, ZenoGem requires only one-tenth the hydraulic retention time or 'Tootprint" to achieve the same degree of BOD, and ammonia removal as the existing WWTP, which currently operates with an average MLVSS concentration of 2,333 mg/L and a hydraulic retention time

of 29.8 hours. The **nitrification** rate for the **ZenoGem** process was 0.26 g **NH₃-N/g nitrified** volatile suspended solids (**NVSS**)-**day** compared to 0.17 g NH,-N/g NVSS-day for the **McAllen** WWTP.

6. Although development of cost estimates for a ZenoGem system to treat McAllen's wastewater in the context of indirect potable reuse was beyond the scope of this study, it is anticipated that a ZenoGem/RO system would be less expensive to construct and operate than the combination of conventional secondary wastewater treatment, Memcor or ZeeWeed MF, and RO.

1.52 Phase I Conclusions

ZeeWeed MF and the Memcor MF systems operating on secondary effluent were compared during Phase I of the study. Conclusions specific to Phase I are presented below:

- 1. Both Memcor and ZeeWeed MF systems achieved a greater-than-planned interval between cleanings during Phase I.
- 2. The rate of fouling of the Memcor membrane was significantly greater than for the ZeeWeed membrane. This suggests that the combination of continuous mechanical agitation and periodic backflushing used for the ZeeWeed membrane are more effective for controlling build-up of material on the membrane surface than the method of intermittent backwashing with air and feedwater method used with Memcor.
- 3. Feedwater recovery for the ZeeWeed MF system during Phase I was approximately 6 to 7 percent higher than the recovery achieved by the Memcor MF system.
- 4. Although results were variable, turbidity and **SDI** for the effluent from both systems were below RO feedwater criterion during most of Phase I operations.
- 5. Neither ZeeWeed nor Memcor MF systems were effective in reducing the dissolved inorganic or organic content of secondary effluent.
- 6. Filtrate from the ZeeWeed MF unit showed higher levels of microbiological contaminants than filtrate from the Memcor MF system during both phases of testing. No fecal or total coliforms were detected in the Memcor filtrate during either phase.
- 7. During treatment with ZeeWeed MF, **pH** increases. This increase most **likely results** from the stripping of carbon dioxide from the secondary effluent by the aeration in the process tank.

8. Control of suspended solids and algae is critical to successful performance and monitoring of the water treatment system.

1.5.3 Phase II Conclusions

During Phase II, the Memcor system continued to operate on secondary effluent while the ZeeWeed system was operated as part of the ZenoGem process. Feedwater for the ZenoGem process was screened and de-gritted wastewater. Operation of the Memcor system during Phase II was compared to Memcor operations during Phase I. Operating results of the ZenoGem process were compared to those from Phase I for the ZeeWeed and Memcor processes; the City's extended aeration wastewater treatment process; and the Memcor process during Phase II. Conclusions for Phase II are presented below:

Memcor

- 1. Chemical cleanings implemented during Phase II were very effective for removing accumulated solids and restoring TMP to the target level of 7 to 8 psi (0.46 to 0.53 bar).
- 2. An increase in filtrate flow during Phase II resulted in an increase in recovery. When filtrate flow was increased during Phase II to 20 gpm (1.26 L/s), recovery rose from 90 to 91 percent.
- 3. Mean filtrate turbidity was lower during Phase II (0.05 **NTU**) than during Phase I (0.12 **NTU**). Additionally, turbidity values were much less variable during Phase II.
- 4. SDI values were similar during Phases I and II.

ZenoGem

- 1. The rate of TMP increase during Phase II was significantly lower than that observed during Phase I. This may be a result of a lower rate of solids loading at the surface of the membrane and/or a greater degree of mechanical cleaning of the membrane surface provided by the higher solids level.
- 2. Phase II recovery was approximately 2 to 4 percent higher and more consistent than that observed during Phase I.
- 3. Turbidity was higher during Phase II for the ZenoGem process than during Phase I for both the Memcor and ZeeWeed MF systems.

- 4. Phase I **SDI** levels for both MF systems were much lower than those observed during Phase II for the ZenoGem process.
- 5. By maintaining higher MLVSS concentrations, the ZenoGem process can attain comparable reduction in BOD, at a much lower hydraulic detention time for the bacterial cells.
- 6. The ZenoGem process has the capability to be operated with longer solids retention times than conventional wastewater processes because it is not limited by sludge bulking that typically occurs at very long detention times.
- 7. **Nitrification** in the ZenoGem process was inhibited during the early periods of testing, but improved dramatically as DO levels were increased.
- a. Oxygen uptake rates in the ZenoGem bioreactor indicated good biological activity as evidenced by the BOD, removals achieved.
- 9. Sludge yields for the **McAllen** WWTP and the ZenoGem process were very comparable.
- 10. The ZenoGem process produced a filtrate having a CBOD, concentration consistently below the discharge requirement of 15 mg/L.
- 11. The ZenoGem process more efficiently removed CBOD, from the raw wastewater than the WWTP, despite operating with one-tenth the hydraulic retention time.
- 12. The ZenoGem process is more than capable of producing an effluent meeting McAllen's current effluent discharge limit.

1.6 Recommendations

The results of this research offer compelling evidence that ZeeWeed is a versatile water reuse technology that can microfilter secondary effluent and clarify activated sludge to qualities suitable for use as RO feedwater. The testing described herein was of limited duration and could not address the critical issues related to the reliability and cost of this technology. Further, the ZenoGem process was limited to operation for basic secondary treatment; capability for its use in the context of sustained **nitrification** or biological **and/or** chemical nutrient removal was not addressed. There is a compelling need for extensive **reseach** to:

1. Determine if **ZeeWeed** can consistently produce the necessary quality filtrate at a sustained flux over many thousands of hours of operation and multiple chemical cleanings (process and product reliability)

- 2. Estimate the full-scale capital and operating costs of ZeeWeed for secondary effluent treatment and of ZenoGem for raw wastewater treatment relative to the currently preferred approach of conventional wastewater treatment and MF
- 3. Establish that ZenoGem is a sufficiently versatile process to be applied not only for secondary treatment but also for high level **nitrification** or biological nitrogen removal (when preceded by **anoxic** treatment)
- 4. Demonstrate that RO can be operated as cost effectively on ZeeWeed or ZenoGem filtrate as on Memcor filtrate

Additional recommendations for future research include:

- 1. Perform a more comprehensive evaluation of ZenoGem on raw wastewater at the **McAllen** SWWTP to:
 - a. Optimize performance characteristics.
 - b. Confirm process reliability.
 - c. Assess operating and maintenance characteristics.
 - d. Evaluate impact of bioreactor conditions (MLVSS and SRT) on filtrate quality, particularly SDI.
 - e. Provide data needed to prepare representative estimates of capital and operating costs for the process.

Operate a RO system on ZenoGem filtrate to:

- 1. Assess RO fouling characteristics of this supply.
- 2. Determine appropriate design criteria for the RO process in the context of indirect potable reuse.
- 3. Assess the quality of RO concentrate and its compatibility with the proposed **means** of discharging concentrate at **McAllen**.
- 4. Demonstrate that the quality of RO product water meets or exceeds IPR requirements.

Pursue in-depth cost analyses of both the ZeeWeed and Memcor MF systems prior to pursuing design of a full-scale water treatment plant using either technology.

Install ammonia feed facilities to prevent free chlorine from combining with trihalomethane (THM) and haloacetic acid (HAA) precursors.

2. STUDY OBJECTIVES

The research to be conducted under this program has five objectives:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the **McAllen** WWTP and compare its cost for McAllen with that established for full-scale IPR projects in California and Arizona.

Compare the ability of ZeeWeed, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the McAllen WWTP.

Evaluate the ability of ZeeWeed MF, when used in conjunction with the ZenoGem process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare ZenoGem **filtrate** quality to that of ZeeWeed and Memcor MF treating secondary effluent.

Compare the operating characteristics of the ZeeWeed MF to Memcor MF, for the purpose of producing an acceptable RO feed for IPR, when used:

- To directly treat secondary effluent
- \cdot In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended **aeration** as performed at the McAllen WWTP by measuring the removal of CBOD,, TSS, and ammonia nitrogen.

3. PILOT PLANT FACILITIES

The pilot plant. facilities used Memcor and ZeeWeed MF systems. The pilot plant consisted of the Memcor and ZeeWeed units, plus **ancilliary** equipment such as a raw water supply pump, piping, valves, and fittings, all of which interfaced with existing McAllen WWTP electrical and piping systems. A description of the other components of the pilot plant facilities is presented in the following sections.

3.1 Raw Water Supplies

During Phase I, the raw water supply to both treatment systems was secondary effluent from the SWWTP. Three sources of secondary effluent were available from the SWWTP as feedwater during Phase I:

Effluent prior to disinfection (unchlorinated effluent)

Effluent disinfected with chlorine

Disinfected effluent subsequently dechlorinated with sulfur dioxide (disinfected, dechlorinated effluent or DDE).

Based on other pilot studies, the Memcor system appears to operate much more efficiently on disinfected effluent because disinfection greatly reduces fouling caused by bacterial loading on the membranes. Historical use of ZeeWeed in the ZenoGem process indicates that the ZeeWeed membrane is not as susceptible to bacterial fouling and should operate with equivalent performance on any of the sources. This is because the bacteria loading and its corresponding fouling is controlled by backpulsing the membranes with chlorinated water every 6 to 12 minutes.

DDE may, however, contain greater concentrations of chlorinated disinfection byproducts (DBPs) that are formed from the reaction of free chlorine and certain organic compounds present in the wastewater. Two of these byproducts, trihalomethanes (THMs) and haloacetic acids (HAAs) are either currently regulated or are scheduled for regulation in drinking water supplies under the Safe Drinking Water Act. Chlorinated DBPs are a concern in the secondary effluent because they are refractory to removal by both MF and RO and may adversely impact the City's ability to produce an acceptable quality of reclaimed water when the reclaimed water is blended with the City's current raw water supply.

Waste-water plants that convert ammonia to nitrite and nitrate through the process of nitrification typically contain insufficient levels of ammonia in the secondary effluent to convert the chlorine applied during the disinfection process to chloramines. Consequently, the free chlorine present during disinfection reacts with the **organics** to form chlorinated **DBPs**. Although the **McAllen** WWTP is not designed to **nitrify**, the warm wastewater temperatures at **McAllen** result in unplanned **nitrification** during a significant portion of the year and produce variable and low levels of ammonia in the

secondary effluent. A review of operating data for the McAllen WWTP for a l-year period indicates that ammonia concentrations vary between <0.1 and 8 mg/L, over as little as a 2-week period. Chlorinated DBP levels in the DDE may be problematic unless ammonia levels are maintained at 0.5 mg/L or greater in the unchlorinated effluent.

The City currently minimizes the formation of chlorinated **DBPs** in their water treatment process by avoiding the use of free chlorine. Chlorine dioxide is used as a pre-oxidant and primary disinfectant; chloramines are used for secondary disinfection. Blending reclaimed water that contains significant concentrations of THMs and HAAs with the City's existing raw water could potentially increase THMs and HAAs in the potable water to unacceptable levels. The U.S. Environmental Protection Agency (EPA) has proposed new regulations that would reduce the maximum contaminant level (MCL) for THMs from 100 micrograms per liter ($\mu g/L$) to 80 $\mu g/L$ and place into effect an MCL for HAAs of 40 $\mu g/L$. This compares to levels of 50 to 250 $\mu g/L$ for these constituents for nitrified and disinfected secondary effluents (Najum, 1997).

An additional concern is that the membrane material used with the Memcor system is intolerant to free chlorine. Any exposure will reduce membrane life. The ZeeWeed membrane material can tolerate continuous high free chlorine levels.

Given these concerns, sampling and analysis for **THMs** and **HAAs** was conducted on a sample of DDE prior to the start of Phase I testing. The results, which are discussed in Section 5, indicated that the best overall source for testing the Memcor and the ZeeWeed MF systems was DDE. Consequently, DDE was used as the feedwater to the two MF units during Phase I.

During Phase II, the water supply for the **ZenoGem** process was screened, de-gritted wastewater while the Memcor unit continued to operate on DDE.

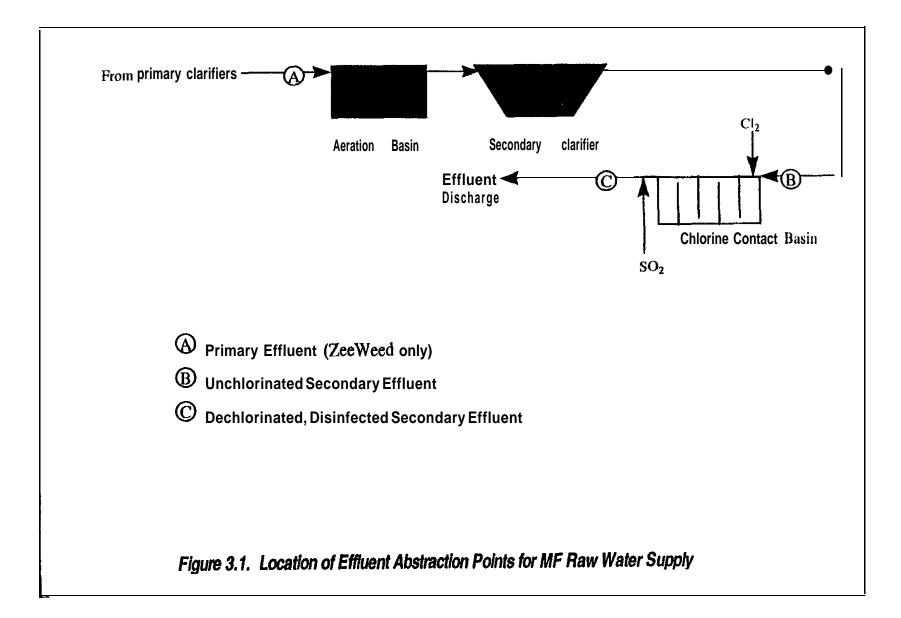
3.2 Raw Water Abstraction and Pumping

DDE was abstracted from the outlet channel of the WWTP chlorine contact basin downstream from the dechlorinating agent (sulfur dioxide $[SO_2]$) injection point. A submersible pump was used to transfer the effluent from the abstraction point to the two treatment systems.

Capability was also provided to abstract unchlorinated effluent from the inlet channel to the chlorine contact basin prior to chlorine injection. However, it was not necessary to use this capability during the study.

Screened, de-gritted wastewater was abstracted from the aeration basin **influent** splitter box and pumped to the ZeeWeed process tank for use in the **ZenoGem** process during Phase II.

Abstraction points relative to the WWTP processes are presented in figure 3.1.



3.3 Raw Water Screening

Raw water to the Memcor MF system was screened using a basket strainer with a nominal retention rating of 500 microns (pm). Screening was necessary to prevent clogging of the inlet distributors of the membrane modules. No screening (other than that provided by the **McAllen** WWTP headworks) was needed ahead of the **ZeeWeed** MF system because there were no inlet distributors to clog.

For the first 2 days of Memcor operation, the basket strainer was incorrectly fitted with a larger one-eighth-inch opening basket. This caused larger-sized particles to clog the **wye** strainer on the suction side of the Memcor feed pump and reduce backwashing effectiveness. The impact of the impaired backwashing on Memcor performance is described in section 5.3.4.1.

3.4 Memcor Microfiltration Treatment System

The Memcor **MF** treatment system consisted of a 100-gallon (379-Liter) break (feed) tank, a feed pump, and three membrane modules plumbed in parallel. Each module contained 162 square feet (ft²) (15 square meters $[m^2]$) of hollow fiber membrane having a nominal pore size of 0.2 microns, The modules are designed to operate in a direct flow configuration where all the feedwater applied to the module flows from outside the fiber through the fiber wall to the inside (lumen) and is collected as filtrate. All modules were operated concurrently to provide a unit capacity of 16 to 20 gallons per minute (gpm) (1.0 to 1.26 liters per second [L/s]), depending on the target flux rate, with **a** module feed pressure of 30 to 35 psig (2.0 to 2.3 bar).

Periodically, the modules were backwashed in a three-step procedure to remove solids that had accumulated on the outer surface of the fibers during the filtration cycle. First, the lumen of each fiber was drained of filtrate. Compressed air was introduced into the lumen of the membrane and subsequently forced through the pores of the membranes to the feed side at high pressure (100+ pounds per square inch gauge [psig] [6.9 + bar]). During this process, solids were displaced from the membrane surface into the spaces between the fibers. In the second step, feedwater was used to flush (sweep) the discharged solids from the modules. The resulting backwash water, containing the solids removed from the modules, was conveyed to a 30-gallon (114-Liter) tank especially designed to dissipate energy in the high velocity, air-containing backwash stream. Equipment used for backwashing included a compressor capable of developing 120 psig (8 bar) air pressure, air receiver, pressure regulator, and coalescer and filter for air drying and filtration.

The backwash water was discharged from the backwash tank to one of the secondary clarifiers by gravity. Filtrate was also discharged to the secondary clarifier.

Backwashing did not completely remove the solids trapped on the membrane surface during filtration and eventually the pressure differential across the membrane

(transmembrane pressure) increased to a terminal value (typically 17 to 18 psig [1.1 to 1.2 bar]). At this point, the membrane modules were chemically cleaned to dissolve and remove the refractory solids. Cleaning solutions were batched in the break tank, recirculated through the modules, and discharged to the sanitary sewer upon completion of the cleaning procedure. With the exception of batching of cleaning solutions and initiation of the cleaning sequence, all operations of the system are automated and controlled by a programmable logic controller (PLC).

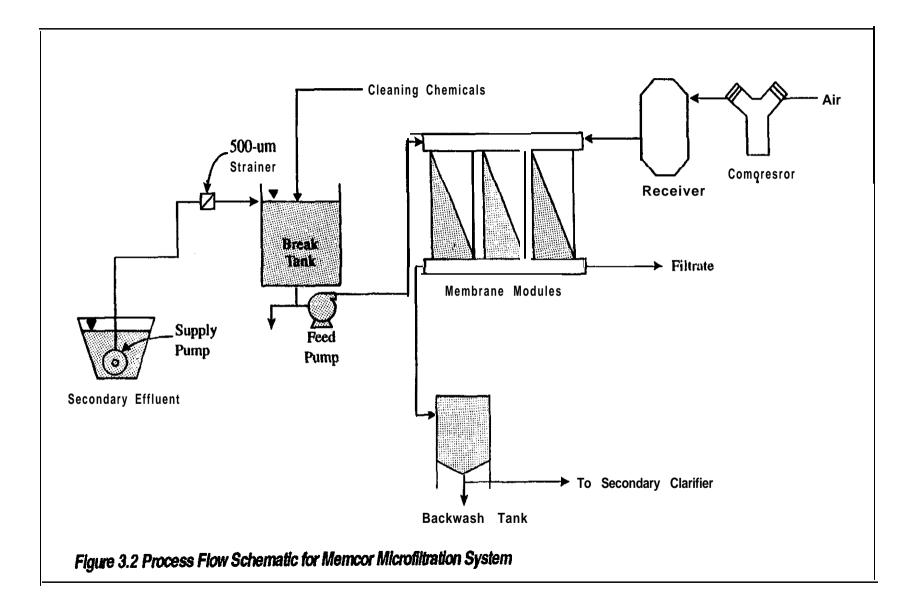
Cleaning was performed seven times using Memtec's proprietary, high-pH caustic/ surfactant proprietary liquid cleaner (Memclean EXA). When this cleaner alone was not successful in reducing transmembrane pressure (TMP) to desired levels, it was supplemented with a separate cleaning using citric acid.

A process flow schematic for the Memcor system is shown in figure 3.2. Photographs of the Memcor system are presented in appendix A.

3.5 ZeeWeed Treatment System

The ZeeWeed model MSTD ZW-4 MF system has a nominal capacity of 3 gpm (0.19 L/s). The system consists of a supply pump, 180-gallon (681 Liter) process tank, one membrane module containing 150 ft^2 (13.9 m²) of hollow fiber membranes with a nominal pore size of 0.1 micron, a process pump, and a blower. In contrast to the Memcor system, whose membrane module consists of a bundle of fibers encased in a pressure vessel, the ZeeWeed membrane module consists of loose fibers connected to a manifold system at either end, with the module suspended in the process tank and submerged in the liquid to be treated. Treatment occurs when a centrifugal (process) pump applies a vacuum of 3 to 9 psig (6 to 18 inches of Hg) to the filtrate side of the fibers. The vacuum causes water in the stream (secondary effluent or mixed liquor) to flow from the feed side to the filtrate side of the membrane in a direct filtration mode under a positive transmembrane pressure.

Solids buildup on the outside surface of the membrane fibers and related increases in filtrate side vacuum is controlled in two ways. First, a blower is used to introduce air (in the form of coarse bubbles) into the bottom of the process tank directly beneath the membrane fibers. The air bubbles flow upward, parallel to and between the vertically oriented fibers, causing the fibers to agitate against one another. This results in mechanical cleaning. Secondly, the fibers are backflushed every 6 to 12 minutes with filtrate (hydraulic cleaning). Typically, a low concentration of chlorine (<5 parts per million [ppm]) is maintained in the backflush water to inactivate and remove microbes (primarily bacteria) that colonize the outer membrane surface. For this study, no chlorine was used in order to minimize formation of THMs and HAAs in the filtrate. Backflushing is accomplished using discharge head from the process tank. To control the buildup of solids in the process tank, a percentage of the tank volume is continuously



extracted using a peristaltic pump. The actual volume of backwash varies depending on the backpulse frequency and duration, but is typically equal to 5 to 15 percent of the filtrate flow from the unit.

ZeeWeed feedwater (either DDE or screened, de-gritted wastewater) was pumped to a **55-gallon (208-Liter)** balance tank using a submersible pump. A grinder-type submersible pump located in the bottom of the balance tank transferred the raw water to the ZeeWeed process tank. Excess flow from the balance tank was recycled by gravity back to the secondary clarifier along with **blowdown** from the process tank and filtrate.

Like the Memcor system, mechanical and hydraulic cleaning does not completely prevent fouling and after some period of operation, filtrate-side vacuum reaches a terminal value (17 to 19 inches of Hg). At this point, the membranes are chemically cleaned with filtrate containing a high concentration of free chlorine (typically 200 ppm). In this pilot study, the ZeeWeed module was not cleaned until the termination of each testing phase.

Some of the filtrate extracted from the module by the process pump is discharged from the system to the secondary clarifier. The remainder is returned to the process pump. This permits separate control of membrane flux and hydraulic retention time (HRT) of feedwater in the tank. When treating secondary effluent, control of HRT is not critical. A process flow schematic for the ZeeWeed system is shown in figure 3.3. Photographs of the ZeeWeed **MF** system are presented in appendix A.

3.6 ZenoGem Operation

Operation of **the** ZeeWeed unit as part of the ZenoGem process is similar to that described in subsection 3.5 except that (1) the rate of filtrate discharge to the secondary clarifier is controlled to achieve the desired HRT in the process tank (bioreactor) and (2) solids buildup in the bioreactor is controlled through once-per-day manual wasting to achieve the desired solids retention time (concentration of mixed liquor suspended solids) in the bioreactor. Proper HRT control is required to achieve the desired degree of CBOD, and ammonia removal by the biomass maintained in the bioreactor. Unlike a conventional **wastewater** treatment plant that operates at MLVSS levels of 2,000 to 3,000 **mg/L**, the ZenoGem process is designed to operate at MLVSS levels of 10,000 to 15,000 **mg/L**. This allows for greater concentration of wastewater microorganisms in the treatment system.

3.7 Criteria for Treatment System Operation

Table 3.1 presents criteria that were established for operation of the two MF systems during the pilot testing. Table 3.2 presents additional criteria used during testing of the ZenoGem process. These criteria reflect the individual manufacturer's experience with

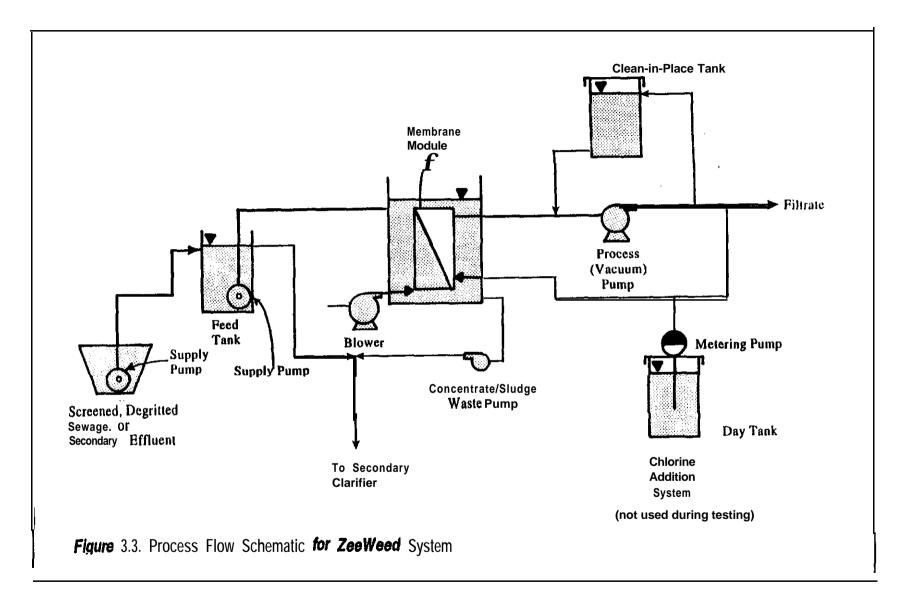


Table 3.1 .- Criteria for Memcor CMF and ZeeWeed MF System Operation

Parameter	Units	Memcor CMF	ZeeWeed MF
Transmembrane Pressure	psi	3 to 20	3 to 9
Membrane Flux	gfd'	35	20 to 40
Backwash/Backpulse Frequency	minutes	15 to 20	6 to 12
Backwash/Backpulse Duration	seconds	90	10
Cleaning Frequency	days	3 to 5	20 to 30

'gfd • gallons per day per square foot of membrane filtering surface

Table 3.2.—Biological Treatment	Criteria for Zeno	Gem Process
---------------------------------	-------------------	-------------

Units	ZenoGem	
mg/L	10,000	
mg/L	>2	
days	2 - 4	
	Units mg/L mg/L	

DDE and (for ZenoGem) screened, de-gritted wastewater. Some of the criteria were modified **during** the study in response to the actual fouling characteristics of the two feed streams from the WWTP. The actual operating criteria are discussed in section 5

.

4. TESTING APPROACH

The two treatment systems (Memcor and ZeeWeed) were operated 24 hours a day, 7 days a week except for cleaning downtimes or planned and unplanned maintenance. The pilot testing program was divided into two phases:

Phase I: Operation of Memcor MF and ZeeWeed MF systems on DDE from McAllen WWTP No. 2.

Phase II: Continued operation of Memcor MF system on DDE; operation of ZeeWeed MF system as part of the ZenoGem process on screened, degritted wastewater.

4.1 Pre-Phase I Activities

Prior to beginning operation of the treatment systems, several preliminary activities were necessary, including characterization of the quality of **McAllen's** current raw water supply and the chlorinated byproduct content of the secondary effluent. These activities are described below.

4.1.1 Raw Water Supply Characterization

The overall goal of IPR is to produce a reclaimed water of suitable quality for supplementing McAllen's current raw water supply. Thus, as part of this study, it was desirable to characterize the quality of the raw water supply and to compare it to **the** quality of reclaimed water produced by MF treatment (but prior to RO treatment).

Raw water characterization was conducted both prior to and during the operation of pilot equipment. A listing of water quality parameters selected for analysis and the laboratory responsible for analysis of each parameter are shown in table 4.1. Analyses were performed by CH2M HILL's Applied Sciences Laboratory and the McAllen wastewater laboratory. Particle counts were measured using a Met-One model WGS-267 grab sample type particle counter.

4.1.2 MF Feedwater Selection

During Phase 1 operation, both MF units were to operate on secondary effluent from the WWTP. Feedwater could be abstracted from one of three sources following secondary treatment. These sources would provide unchlorinated secondary effluent, chlorinated secondary effluent, or dechlorinated secondary effluent. As discussed in section 3, proper feedwater selection required that the levels of selected **DBPs** in the chlorinated secondary effluent be quantified.

		rce vvater Charaterizatio	
Parameter	No. Of Samples	Analytical Method	Responsible Laboratory
Inorganics			
Bromide	2	EPA 300	McAllen
Barium	2	EPA 200.7	McAllen
Calcium	2	EPA ZOO.7	McAllen
Magnesium	2	EPA 200.7	McAllen
Strontium	2	EPA ZOO.7	McAllen
Potassium	2	EPA 200.7	McAllen
Sodium	2	EPA 200.7	McAllen
Iron	2	EPA ZOO.7	McAllen
Manganese	2	EPA 200.7	McAllen
Aluminum	2	EPA 200.7	McAllen
Bicarbonate	2	EPA 310.1	McAllen
Carbonate	2	EPA 310.1	McAllen
Chloride	2	EPA 300	McAllen
Fluoride	2	EPA 300	McAllen
Sulfate	2	EPA 300	McAllen
Nitrate	2	EPA 300	McAllen
Phosphorous	2	EPA 365.1	McAllen
Silica	2	EPA 200.7	McAllen
TDS	2	SM 52108	McAllen
Organics			
TOC	2	EPA 110.2	CH2M HILL
Color	2	EPA 415.1/2	CH2M HILL
UV Absorbance	2	SM 5910 A	CH2M HILL
THMFP (96-hr)	2	SM 5710 D	CH2M HILL
HAAFP (96-hr)	2	SM 5710 D	CH2M HILL
Physical/Chemical			
Temperature	2	Not Applicable	McAllen
pH	2	SM 4500 H	McAllen
Turbidity	2	SM 2130 B	McAllen
SDI	2		McAllen
Particle Count	2	Met-One Model 567	McAllen
		Particle Counter	
Microbial			
Total Coliform	2	SM 9222 D	McAllen
Fecal Coliform	2	SM 9222 D	McAllen
	2	SM 9215 B	McAllen

Table 4.1 .- Source Water Charaterization

To evaluate DBP levels, a sample of DDE was collected on February 25, 1997, and analyzed for levels of **THMs** and **HAAs**. (Disinfected secondary effluent at the McAllen WWTP is dechlorinated prior to discharge to conform to requirements of their National Pollution Discharge Elimination System [NPDES] permit.) A sample of unchlorinated secondary effluent was also analyzed to determine the levels of these contaminants before chlorination. Analyses were performed by the CH2M HILL Applied Sciences Laboratory. The results, which are presented and discussed in section 5.0, indicated low levels of both byproducts in the chlorinated secondary effluent and supported the use of DDE for MF feedwater.

4.2 Phase I

Phase I testing was conducted from April 10 through June 18, 1997, for the Memcor system and from April 14 through June 15, 1997, for the ZeeWeed system. Both MF systems were operated on a common raw water supply of DDE.

The objectives of Phase I were to:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the McAllen WWTP.

Compare the ability of ZeeWeed, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the McAllen WWTP.

The focus during Phase I was to first establish and maintain system operation at the manufacturer's recommended criteria, observe resulting performance, and then, using these results, optimize operating conditions. The following response variables were monitored and evaluated during the initial period of operation and used to perform the optimization:

Filtrate quality (as measured by turbidity, SDI, and level of indicator microorganisms).

Rate of TMP increase with operating time, initially and following each chemical cleaning.

Effectiveness of cleaning in reducing membrane fouling as measured by reduction in TMP.

4.3 Phase II

Phase **II** testing was conducted from June 19 through August 15 for both treatment systems. The specific objectives of this phase of testing were to:

Evaluate the ability of ZeeWeed MF, when used in conjunction with the ZenoGem process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare ZenoGem filtrate quality to that of ZeeWeed and Memcor MF treated secondary effluent.

Compare the operating characteristics of the ZeeWeed MF when used:

- 1. To directly treat secondary effluent.
- 2. In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended aeration as performed at the **McAllen** WWTP by measuring the removal of CBOD,, TSS, and ammonia nitrogen.

The ZenoGem process incorporates ZeeWeed for retention and clarification of biological solids used for secondary treatment. In this phase, testing of the ZenoGem system has two goals:

Biologically treat the screened, de-gritted wastewater to produce a "secondary effluent" meeting or exceeding the quality requirements of the City. These requirements include producing an effluent that meets all the requirements of the City's **NPDES** permit for surface discharge.

Microfilter the "secondary effluent" to a quality suitable for use as RO feedwater and equivalent to that produced by the Memcor and ZeeWeed MF systems when treating secondary effluent (demonstrated during Phase I).

The Memcor system operation continued as in Phase I. The ZeeWeed system was operated on screened, de-gritted wastewater.

Response variables for Memcor and the ZeeWeed MF system are as listed under Phase 1. Response variables for the biological treatment portion of the ZenoGem process are as follows:

> Oxygen uptake rate (OUR) Filtrate CBOD, Filtrate TSS Filtrate nutrients (nitrogen species and total phosphorus)

The results of Phase I and Phase II testing are discussed in section 5.0.

.

4.4 Treatment System Monitoring

During the testing phases, various performance parameters were monitored to evaluate operation of the treatment systems and the quality of the water fed to and produced by the systems. The parameters that were monitored are presented in the following sections.

4.4.1 Microfiltration System Operating and RO Feedwater Quality Parameters

Operating parameters for the **MF** systems were monitored on a daily basis by **McAllen** personnel to evaluate the treatment systems. Additionally, the effluents from the **MF** systems were monitored on a daily basis to evaluate the suitability of the effluent for processing by RO.

The operating parameters that were monitored are presented in table 4.2. The RO feedwater quality parameters, the monitoring frequency, responsible analytical party, and analytical methods are presented in table 4.3. All water quality samples were collected by McAllen personnel.

	I memcor P	nases 1 and 1	
Parameter	Unit	Memcor	ZeeWeed
Feed Pressure	psig	Х	
Filtrate Pressure	psig	Х	
Filtrate Vacuum	in. Hg		Х
Feed Flow	gpm	Х	
Filtrate Temperature	deg C.	Х	Х
Filtrate Flow	gpm	Х	Х
Backwash (pulse) Frequency	min	Х	Х
Backwash Duration	sec	Х	Х
Process Tank Waste Rate	qpm		Х

Table 4.2Monitored Operating Parameters for MF Systems
ZeeWeed and memcor Phases 1 and II

			Monitoring Frequency	1
Parameter	Analytical Laboratory	Feedwater'	ZeeWeed Filtrate	Memcor Filtrate
Turbidity	McAllen	1/day		
Silt Density index	McAllen	None	l/day	1/day

Table 4.3.—Monitored RO Feedwater Quality Parameters ZeeWeed and Memcor Phases I and II

¹ Feedwater to ZenoGem process during Phase II not monitored for these parameters

4.4.2 ZenoGem Process Operating and Water Quality Parameters

Additional parameters were measured in the bioreactor to control operations in the biological treatment portion of the ZenoGem process. Additional water quality parameters were also **monitored** to evaluate the effectiveness of the ZenoGem process for biological treatment. All samples were collected by McAllen personnel on a weekly basis. The biological treatment operating and water quality parameters are presented in tables 4.4 and 4.5, respectively.

Table 4.4Monitored Biological Treatment Operating Parameters
ZenoGem Process Phase II

Zenogeni	FIUCESS FIIASE II	
Parameters	Analytical Laboratory	Monitoring Frequency
Dissolved Oxygen	McAllen	l/week
Mixed Liquor Suspended Solids	McAllen	l/week
Oxygen Uptake Rate'	CH2M HILL	l/week
Mixed Liouor Volatile Suspended Solids	McAllen	l/week

¹ OUR is a calculated value. the equation for calculating OUR is: OUR (mg/L/hr)+ Average DO (mg/L/min) X 50 min/hour

		ZenoGerr	n Process Phase	e II		
Parameters	Analytical Laboratory	Analytical Method	ZenoGem Feed	Z e n o G e m Filtrate	WWTP Feed	W W T P Effluent
CBOD₅	McAllen	SM 521 OB	Х	Х	Х	Х
Ammonia Nitrogen (NH3-N)	McAllen	SM 4500- NH3-F	Х	Х	Х	Х
Total Kjeldahl Nitrogen (TKN)	CH2M HILL	EPA 351.4	Х	Х		
Nitrite and Nitrate Nitrogen	CH2M HILL	EPA 353.2	Х	Х		
Total Phosphorus	CH2M HILL	EPA 365.1	Х	Х		

Table 4.5.—Monitored Biological Treatment Water Quality Parameters

4.4.3 Other Water Quality Parameters

Additional water quality parameters were monitored for the Memcor and ZeeWeed MF systems to evaluate the operation and effectiveness of the MF systems relative to overall water goals for IPR. These are presented in table 4.6 along with the monitoring frequency, responsible analytical laboratory, and analytical method. All samples for water quality analysis were collected by McAllen personnel.

4.5 Data Evaluation

Several of the operating parameters and water quality parameters presented above, as well as some of the operating criteria presented in section 3.0 were compiled, reduced, and analyzed to evaluate operation of the treatment systems.

The MF system operating parameters and RO feedwater quality parameters that were used to evaluate and compare the MF systems are presented in table 4.7 and discussed below. In addition to the parameters presented in table 4.7, all of the water quality parameters presented in table 4.6 were used to evaluate the MF systems. Additionally, operating and water quality parameters presented in tables 4.4 and 4.5 were used to evaluate the biological treatment portion of the ZenoGem process.

	Memcor an	d Zeeweed Pha	se i and li		
Parameter	Analytical	Analytical	Feedwater	ZeeWeed	Memcor
	Laboratory	Method		Filtrate	Filtrate
Total Dissolved	McAllen	SM 521 OB	l/month	.l/month	l/month
Solids					
Conductivity	McAllen	SM 521 0B	1/day	1/day	1/day
Total Organic Carbon	CH2M HILL	EPA 110.2	2 / month	l/week	1/week
Color	CH2M HILL	EPA 415.112	2 / month	l/week	l/week
UV Absorbance @	McAllen	SM 5910A	1/week	3/week	3/week
254nm					
THMs	CH2M HILL	SM 5710.D	1 /test	l/test	1/test
			period	period	period
HAAs	CH2M HILL	SM 5710.D	1 /test	1/test	1/test
			period	period	period
pН	McAllen	SM 4500H	1/ day	1 /day	l/day
Particle Count	McAllen/MetOne	NA'	None	3/test	3/test
				period	period
Heterotrophic Plate	McAllen	SM 92158	None	1/test	l/test
Count				period	period
Total Coliform	McAllen	SM 9222D	None	1 /test	l/test
				period	period
Fecal Coliform	McAllen	SM 9222D	None	1/test	1/test
				period	period

Table 4.6.—Other Monitored Water Quality Parameters for MF Systems
Memcor and ZeeWeed Phase I and II

¹ A Met-One model WG-267 on-line particle counter was used to measure particle counts in the filtrate.

Table 4.7.—Microfiltration System Operating and RO Feedwater Quality Output Parameters Memcor and ZeeWeed MF Systems

 Operating Parameter
Filtrate Flow
Membrane Flux
Transmembrane Pressure
Feedwater Recovery
Feedwater Turbidity
Filtrate Turbidity
 Filtrate SDI

Filtrate Flow and Membrane Flux. Filtrate flow and membrane flux target levels were established by the manufacturers at the start of Phase I. These target levels were controlled as closely as practical during the testing period by manual adjustment of the filtrate flow control valve on each unit. Membrane flux is directly proportional to filtrate flow based on equation 1:

$$J = (Q_f \times 1440) / A_m$$
 (1)

where:

J = membrane flux in gallons per day per ft^2 (gfd) Q_f = filtrate flow in gpm A_m = membrane filtering surface area, ft2

Transmembrane Pressure. TMP represents two factors: the resistance to the flow of water of (1) the membrane and (2) materials in the feedwater (foulants) that accumulate at the membrane surface or within the membrane pores. TMP at the start of the test (with a clean membrane) represents only the resistance of the membrane. As **foulants** accumulate and cannot be effectively removed by **backwashing/pulsing**, the TMP increases in relation to the resistance to flow exerted by the foulants. Thus, the rate of increase in TMP is directly proportional to the rate of membrane fouling.

Feedwater Recovery. Feedwater recovery represents the percentage of treated feedwater that; is converted to filtrate. For the Memcor unit, recovery is defined according to equation 2:

$$Y = [(Q_f x T_{fc})/(Q_f x T_{fc} + V_b)] x 100$$
(2)

where:

Υ	=	recovery, expressed as a percentage
$Q_{\rm f}$	=	filtrate flow, gpm
T_{fc}	=	filtration interval (time between backwashings), minutes
V,	=	volume of backwash water, gals

Feedwater recovery for the **ZeeWeed** unit is defined according to equation 3:

$$Y = [(Q_f X T_{fc})/(Q_f X T_{fc} + V_b)] X 100$$
(3)

where:

Y =	recovery,	expressed	as	а	percentage
-----	-----------	-----------	----	---	------------

- \mathbf{Q}_{f} = filtrate flow, gpm
- $T_{fe} =$ filtration interval (time between bioreactor tank liquid wasting), minutes
- V_{b} = volume of liquid wasted from the bioreactor tank, gals

The liquid volume wasted from the bioreactor tank is synonymous with the sludge volume wasted as discussed later in this report.

Turbidity and SDI. The primary water quality parameters used to judge the effectiveness of the MF treatment processes in producing a high quality RO feedwater are turbidity and silt density index (SDI). Traditionally, the RO membrane manufacturers have established the following as criteria for efficient RO operation:

turbidity: ≤0.2 NTU

SDI: <3 (based on 15-min test interval)

SDI is defined by equation 4:

 $SDI = 100 \text{ x } [1 - T_i / T_f] / T_t$

(4)

where:

\mathbf{T}_{i}	=	time to filter initial 500 ml of Memcor/ZeeWeed filtrate, min
T_{f}	=	time to filter final 500 ml of Memcor/ZeeWeed filtrate, mm
T_t	=	time between from start of \mathbf{T}_{i} to start of \mathbf{T}_{f} , min

5. PILOT TESTING RESULTS

This section presents the results of Phase I and Phase II testing. All data collected during the study are presented in appendix B as follows:

Operating data for Memcor, Phases I and II:	Table	B-l
Operating data for ZeeWeed (ZenoGem), Phase II:	Table	B-3
Water quality data for Memcor, Phases I and II:	Table	B-4
Water quality data for ZeeWeed, Phase I:	Table	B-5
Water quality data for ZeeWeed, Phase II:	Table	B-6

CH2M HILL laboratory reports containing analytical data and quality assurance/ quality control information are presented in appendix C. Results for water quality parameters **analyzed** by the **McAllen** water and wastewater laboratories were communicated to CH2M HILL by facsimile on daily or weekly sampling logs. These data, along with CH2M HILL laboratory data were tabulated and incorporated into tables B-4 through B-6 in appendix B.

5.1 DBP Characterization of Disinfected, Dechlorinated, Secondary Effluent

As described in Section 4, samples of unchlorinated secondary effluent and DDE were collected prior to the start of testing and analyzed for THMs and HAAs to assess the potential for regulated DBPs to be present in the reclaimed water. The results, shown in table 5.1, indicate very low levels of both THMs and HAAs (around 10 μ g/L or less) in both sources. The low levels in the unchlorinated effluent indicate that any DBPs present in the City's finished water have degraded between distribution and collection as wastewater. The low levels of DBPs present in the DDE reflect the presence of sufficient ammonia in the secondary effluent at the time of sample collection (0.68 mg/L as N) to react with and convert the free chlorine to combined chlorine (chloramines), thereby inhibiting the formation of THMs and HAAs. Ammonia levels vary significantly in the secondary effluent (from <0.1 to >8 mg/L) and DBP analysis of samples collected where ammonia levels are lower would most probably show greater DBP concentrations Full-scale implementation of IPR may require that a minimum ammonia level, be maintained prior to disinfection to minimize DBPs in the reclaimed water.

5.2 Source Water Characterization

Two sets of samples were to be collected from McAllen's raw water reservoir prior to Phase I operations. These samples were to be analyzed for inorganics, organics, physical/chemical parameters, and microbial parameters to characterize the quality of the existing **raw** water supply. The first set of samples was collected during the first quarter on March 11, 1997, and shipped to the CH2M HILL laboratory for analysis of inorganics and organics. However, due to a communications error, no samples were collected for analysis of physical/chemical or microbial parameters.

	Dechlorinated Secondary Enluent	
Source	THM Concentration (µg/L) HA	As Concentration (µg/L)
Unchlorinated effluent	¹ <2	4.2
Disinfected/dechlorinated effluent (DDE)	²<5	6.3

Table 5.1	DBP Concentrations in Unchlorinated a	and Disinfected/
	Dechlorinated Secondary Effluent	

¹ Level of each of four THM species was less than $1-\mu g/L$ detection limit. ² Levels of three of four THM species were less than $1-\mu g/L$ detection limit.

Fourth species was measured at 1.9 µg/l.

Additional samples were collected on June 2 through June 4, 1997. The June 2 samples, representing the second sampling event, were analyzed for inorganic compounds and physical/chemical parameters. A second set of samples was collected on June 4 and analyzed for **physical/chemical** parameters only (to account for the omission of sampling for these parameters on March 11, 1997). However, no samples were collected as scheduled on June 2 and 4 for analysis of microbial parameters. Therefore, additional samples were collected on September 3 and September 25 for analysis of microbial parameters.

Particle counts were obtained on samples collected on June 3 and June 4, using a grab sample particle counter provided by Met-One and installed temporarily at Water Treatment Plant No. 2.

Source water characterization data are presented in tables 5.2 through 5.4. The data indicate that, McAllen's raw water source:

· Is moderately turbid

Contains high levels of dissolved solids, especially hardness and sulfate

Contains moderate levels of organic matter, particularly compounds that form **THMs** when exposed to free chlorine

Shows evidence of pollution, e.g., low but measurable concentrations of nitrate and phosphorus and fecal and total coliforms

Has high RO membrane fouling and scaling potential as evidenced by high turbidity, **SDI** and particle counts, and elevated concentrations of the sparingly soluble salts, barium, calcium, strontium, bicarbonate, and sulfate

	1 Hyorodi	Result		
Parameter	3/11/97	6/2/97	6/4/97	Units
norganics				
Alkalinity	130	106	NS'	mg/L ^{2,3}
Bicarbonate	159	129	NS	mg/L
Carbonate	1	<2.0⁴	NS	mg/L
Bromide	0.1	0.54	NS	mg/L
Chloride	155	207	NS	mg/L
Color, Apparent	17	10	NS	color units
JV-254	0.112	0.092	NS	1/cm
Fluoride	0.59	0.99	NS	mg/L
litrate	0.58	<0.1 0	NS	mg/L
otal Phosphorus	0.05	co.05	NS	mg/L
Silica-Reactive	6	13.55	NS	mg/L
TDS	720	772	NS	mg/L
Sulfate	247	262	NS	mg/L
Aluminum	1.22	0.248	NS	mg/L
Barium	0.127	0.124	NS	mg/L
Calcium	77	77.7	NS	mg/L
ron	0.77	0.171	NS	mg/L
Magnesium	22.1	27.9	NS	mg/L
Manganese	0.025	0.018	NS	mg/L
Potassium	9	9.58	NS	mg/L
Silicon	6.94	6.3	NS	mg/L
Sodium	102	140	NS	mg/L
Strontium	2.05	2.4	NS	mg/L
Fotal Hardness	285	311	NS	mg/Lc
Organics				
-OC	3.7	3.9	NS	mg/L
SDS HAAS ⁶	58	72	NS	μg/L
SDS THM ⁷	236	215	NS	µg/L
Physical/Chemical				
Femperature	NS	28	28	۰C
ЭH	NS	8.1	8.1	Units
Furbidity	NS	11.2	18	NTU
Silt Density Index	14.6	15.6	NS	unitless
² mg/L - milligra 'Alkalinity and to ⁴ <x.x -="" compou<br="">⁵ Calculated values ⁵ Ca</x.x>	otal hardness rea Ind not detected ue	sults repotted as above laboratory	CaC03 / detection limit p pacetic acids (5 s	

Table 5.2.—Source Water Characterization - Inorganic, Organic and Physical/Chemical Parameters

'SDS THM • Simulated distribution system trihalomethanes

Table 5.3So	irce Water Chara	cterization - Micro	bial Parameters
Parameter	9/3/97	9/25/97	Units
Total Coliform	20	20	CFU/1 00 ml
Fecal Coliform	4	6	CFU/1 00 ml
HPC	1,200	1,100	CFU/ml

	able 5.450		naracienzalic	n - Fanici		
I		6/3/97			6/4/97	
Panicle Size (microns)	Mean	Minimum	Maximum	Mean	Minimum	Maximum
2.0 to 3.0	1,257	1,126	1,345	999	917	1,126
3.0 to 5.0	5,788	5,012	6,226	4,968	4,578	5,435
5.0 to 8.0	7,919	7,022	8,376	8,155	7,824	8,545
8.0 to 10.0	2,659	2,442	2,832	3,551	3,143	3,827
10.0 to 15.0	1,965	1,040	2,319	3,087	2,573	3,604
> 15.0	658	348	1,366	713	537	966
Total'	21,063	19,466	20,983	21,472	20,978	21,950

Table 5.4.-Source Water Characterization - Panicle Counts

¹ All particles > 2.0 microns in diameter.

Comparison of results between sampling events indicates that the raw water quality is quite consistent over a **3-month** period.

5.3 Phase I Testing

5.3.1 Objectives

The objectives for Phase I were to:

Confirm the applicability of the Memcor MF system for RO pretreatment of secondary effluent from the McAllen WWTP.

Compare the ability of **ZeeWeed**, a novel microfiltration technology, to provide an RO feedwater of quality equivalent to Memcor filtrate when processing secondary effluent from the **McAllen** WWTP.

5.3.2 Operations

The Memcor and **ZeeWeed** MF systems operating on DDE were commissioned during the week of April 7, 1997. Field service representatives from the two manufacturers were **onsite** during this period to start-up their respective systems and train **CH2M** HILL and McAllen personnel regarding operation and maintenance requirements. Phase I operations officially commenced on April 14 and were completed for the Memcor and ZeeWeed systems on June 18 and 16, respectively. Operation of each of the MF systems is discussed below.

ZeeWeed. The ZeeWeed system achieved steady-state operation (concentration of secondary effluent to 95 percent recovery in process tank) on April 11. From April 14 through June 16, the unit accumulated 1,492 operating hours out of a total of 1,493 available hours for an on-line factor of nearly 1 (100 percent). This on-line factor does not account for the three separate periods when the unit was off-line because of a high process pump discharge pressure condition that occurred during backpulsing when the pilot plant operator was not present (off hours). This condition was easily rectified by adjusting a pressure control valve and is not considered a process failure. The one hour of unavailability was a result of the need to replace a section of tubing on the peristaltic pump used to withdraw concentrate from the process tank (three separate events).

No chemical cleanings were conducted on the ZeeWeed MF system during Phase I. The ZeeWeed MF unit was cleaned and prepared for Phase II operation at the end of Phase I. Cleaning activities were performed by a Zenon representative on June 16 and June 17, 1997. The Zenon representative noted a significant amount of green algae in the system and also observed that the membranes were very dirty and contained a brown slime. The cleaning procedures that were followed are presented in appendix D.

Water fluxes were performed on the membranes prior to the cleaning operations and between each cleaning step. The results of each water flux are presented in table 5.5. The results indicate that the first two cleanings were only partially effective in restoring flux to "clean" conditions and that an overnight soak was needed to fully reverse the effects of membrane fouling.

Memcor. The Memcor system was placed into service at design conditions on April 10. From April 14 through June 18, the Memcor unit accumulated nearly 1,459 operating hours out of a total of 1,566 available for an on-line factor of 0.93. The unit was removed from service by the pilot plant operator on April 24, April 29, and June 10 to perform a series of chemical cleanings in an attempt to reverse increases in TMP resulting from membrane fouling. Cleaning was conducted on April 24 using Memclean EXA (proprietary blend of caustic and surfactant) followed by sequential cleaning with citric acid and Memclean EXA on April 29. This series of cleanings was only partially successful and on May 13, a Memtec service technician removed the unit from service and subsequently weighed modules to determine mass of foulant accumulated, removed fibers for off-site **foulant** analysis, performed two additional cleanings, and reprogrammed the cleaning cycle in the PLC. Memclean EXA was used during both cleanings, however an overnight soak was incorporated into the first cleaning. These cleanings were effective in reducing the TMP to near initial levels. The June 10 cleaning was conducted using Memclean EXA and it, too, was effective in reducing the TMP to near initial levels. Table 5.6 summarizes available data for each cleaning conducted during Phases I and II.

	Filtrate flow		Vacu		
Activity	Before backwash (Lpm)	After backwash (Lpm)	Before backwash (inches Ho)	After backwash (inches Hg)	Temperature (∘F)
Water flux before cleaning	12	13	15	13.5	32
Clean water flux after initial flushing of process tank	12	13	15	13.5	32
Clean water flux after first NaOCI cleaning	10	10	11	10	30
Clean water flux after second NaOCI cleaning	12	12	10	10	30
Clean water flux after NaOCI overnight soaka	NA	15	NA	4.5	28

Table 5.5.-Results of ZeeWeed MF System Cleaning After Phase I Operations

'Additional measurements include: Flux at 28°C - 38.04 GFD

Flux at 28°C • 38.04 GFD Flux at 25°C • 37.30 GFD

Permeability at 25°C - 14.92 GFD/psig

	1401			eyeterni eleannige	
Date	Operating Time (hours)	TMP before Cleaning (psi)	TMP after Cleaning (psi)	Cleaning Chemical(e)	Soak Duration
4/25/97	325	16.0	11.9	1. Memclean EXA 2. Citric Acid	1. 1.5 hours 2. 2 hours
4/29/97	417	13.3	11.6	1. Citric Acid 2. Memcor EXA	1. 1.5 hours 2.2 hours
5/13/97	721	12.5	6. 3	1. Memclean EXA 2. Sodium Hydroxide	1. 1 hour 2.2 hours
6/10/97	1370	19.7	11.2	Memclean EXA	Not Recorded
6/24/97	1684	11.4	6. 6	Memclean EXA	2 hours
7/17/97	2215	17.1	6. 5	Memclean EXA	3 hours
8/2/97	2563	17.4	7.7	Memclean EXA	2 hours

Table 5.6.-Phase I and II Memcor MF System Cleanings

5.3.3 Operating Conditions

ZeeWeed. Table 5.7 presents the operating conditions for the two systems, both as planned and. as achieved during the reporting period. The ZeeWeed unit was operated according to plan except for backpulse frequency, which was performed every 5 minutes

instead of every 6 to 10 minutes, as planned. The change was made between Work Plan preparation and plant commissioning following additional discussions with Zenon technical representatives regarding the need to minimize the formation of DBPs in the filtrate. To address this need, Zenon recommended eliminating chlorine during back pulse and increasing the back pulse frequency to compensate for the absence of chlorine. Cleaning frequency was undetermined because no cleanings were performed.

	nu Actual Opera	aling raian		Oystems	
		Zee	Weed	Mer	ncor
Parameter	Unit	Planned	Actual	Planned	Actual
Filtrate Flow	gpm	2.1 - 4.2	2.6 • 3.8	19.8 - 22.5	15.2 20.3
Transmembrane Pressure	psi	3 - 9	3 • 8.6	6 - 17	7.7 - 19.7
Membrane Flux	gfd'	20 - 40	25.4 • 36.8	26 • 30	20.2 - 27.0
Back Wash/Pulse Frequency	minutes	6-12	5	15-20	20
Back Wash/Pulse Duration	seconds	10	10	90	90
Back Wash/Pulse Chemical Addition	not applicable	chlorine	none	none	none
Cleaning Frequency	days	20-30	>48	3 - 5	14.1

Table 5.7.-Planned and Actual Operating Parameters for MF Systems

 1 gfd = gallon/square foot/day

Memcor. The Memcor unit was operated at lower than planned flux during all but the initial 200 hours of Phase I operation. Flux was reduced after this period in response to rapid membrane fouling and at the recommendation of the manufacturer. (See further description of fouling in section 5.3.4.1, below.)

The Memcor unit achieved a greater than planned interval between cleanings during Phase I. Other operating parameters were as planned.

5.3.4 Phase I Testing Results

The following sections present the testing results for the Memcor and ZeeWeed MF systems during Phase I. Results for MF system operating parameters, feed and filtrate turbidity, and filtrate SDI are presented graphically and discussed in the following sections. All other water quality data are shown in table 5.8 as mean, minimum, and maximum values based on all data collected during this phase. Turbidity and SDI data are also presented in this manner in table 5.8.

			mcor a	nd Zeew	leed MF S	ystems - I	nase				
	o, of S	Samples		Feedwate	r	ZeeW	/eed <u></u> MF ^F ∣	trate	Memc	or MF Fi	ltrate
Parameter	-eed	Filtrate	Mean	Min	Max	Mean	Min	Max	Mean	Mi"	Max
TDS (mg/L)	5	4-6	1,191	964	1,407	1.216	975	1,410	1,211	977	1,411
Conductivity (µs/cm)	63	63	1,970	1.520	2,500	2.027	1,575	2,625	2,002	1.560	2,410
TOC (mg/L)	3	6	7.6	6.9	6.4	7.4	6.7	6.1	7.5	6.9	6.1
Color (color units)	3	5	10.17	2.5	23	7.6	0.0	15.0	7.0	0.0	17.0
UV Absorbance @ 254 (1/cm)	8	12-1:	0.117	0.106	0.147	0.120	0.106	0.142	0.117	0.101	0.139
SDS THM (μ g/L)	1	1	333.7	333.7	333.7	269.4	269.4	269.4	324.4	324.4	324.4
SDS HAA (µg/L)	1	1	127.4	127.4	127.4	127.0	127.0	127.0	130.6	130.6	130.6
pH (µg/L)	63	63	7.06	6.67	7.41	6.07	6.97	6.36	7.13	6.66	6.16
Turbidity (NTU)	65	63	2.94	1.00	26.0	0.13	0.03	0.57	0.13	0.03	0.53
SDI	0	41-45	NS	NS	NS	2.66	0.13	6.10	2.46	0.40	7.60
HPC (CFU/ml)	7	3-7	4.682	676	16,100	3.216	400	13.000	1.655	264	2,600
Total Coliform (CFU/100 ml)	7	3-7	17	3	31	8	1	16	ND	ND	ND
Fecal Coliform (CFU/100 ml)	7	57	2 3	2	50	14	1	44	ND	ND	ND

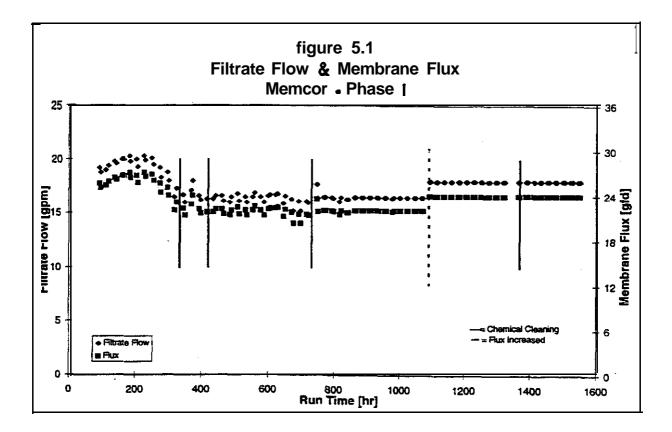
Table 5.8.—Phase I Microfiltration Water Quality Parameter Results

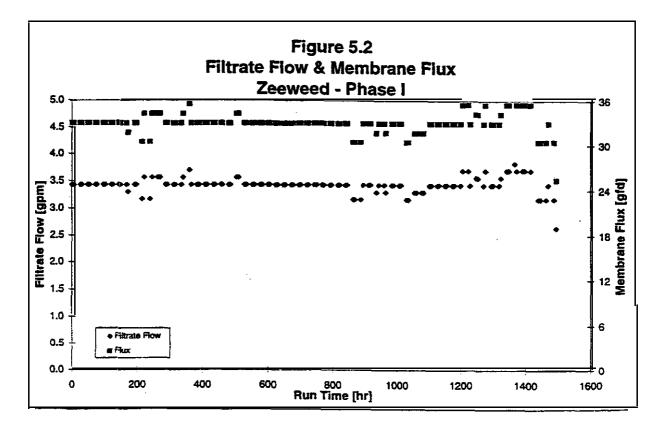
¹ When the number of samples varied for Memcor and ZeeWeed filtrate due to reasons such as equipment downtime, a range is presented.

5.3.4.7 Operating and RO Feedwater Quality Parameters

Filtrate Flow and Membrane Flux. Figures 5.1 and 5.2 present the filtrate flow and membrane flux for the Memcor and ZeeWeed MF systems, respectively.

Memtec personnel directed system operators to reduce the Memcor filtrate flow from target levels after 190 hours of operation in an attempt to reduce the rate of membrane fouling. The rapid fouling was attributed to inefficient sweeping of solids out of the membrane module during backwashing. The cause of the inefficiency was attributed to a clogged **wye** strainer on the suction side of the feed pump that restricted flow to the modules during the sweep portion of the backwash. Wye strainer clogging resulted when a strainer basket having openings of one-eighth inch was inadvertently used instead of the correct **500-µm** basket during the **first** 2 days of operation. This mistake allowed larger particles to pass through the pre-screen. The clogged suction strainer condition was recognized and rectified. Filtrate flow and flux were increased back to target levels at approximately 1,125 operating hours following the **field** visit by Memtec's technician and successful cleaning of the membranes.





ZeeWeed **unit** filtrate flow and membrane flux were stable and effectively maintained at target levels during the **first** 1,400 hours of Phase I, although the parameters began a sharp decrease at that point that continued for the remainder of Phase I. The decrease occurred when the filtrate vacuum reached its maximum value and additional TMP could not be attained, resulting in a drop in filtrate flow as the membranes continued to foul.

Transmembrane Pressure. Figure 5.3 presents the TMP values for the Memcor and ZeeWeed MF systems during Phase I as a function of operating time. The following can be concluded from an examination of the figure:

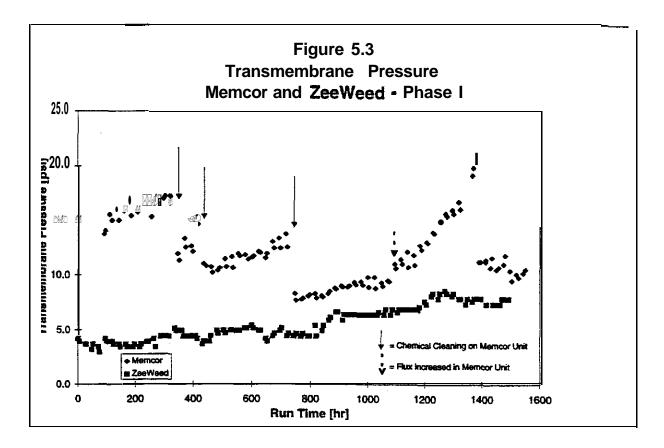
Initial TMP for the ZeeWeed **MF** system is approximately 3 psi (0.2 bar) compared to approximately 5 psi (0.33 bar) for the Memcor MF system. Initial TMP would be even greater for Memcor if the unit were operated at the higher flux used with ZeeWeed. These results indicate that the ZeeWeed membrane has a higher permeability (lower resistance to water flow) than the Memcor membrane.

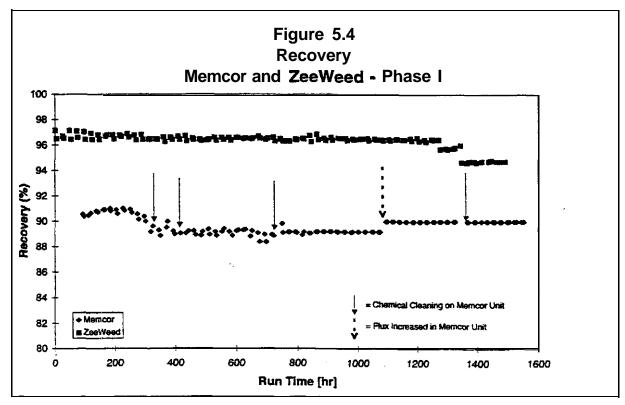
The rate of fouling of the Memcor membrane is significantly greater than for the ZeeWeed membrane even after the backwashing difficulties with Memcor MF system were rectified. The rate of TMP increase for Memcor during the period following the field technician's visit and related cleaning (best performance period) was 0.24 psi/day (1.68 kPa/day) versus 1.46 psi/day (10.2 kPa/day) for the entire operating period of ZeeWeed operation.

The lower ZeeWeed fouling rate suggests the combination of continuous mechanical agitation and periodic hydraulic back flushing are **more** effective for controlling buildup of material on the membrane surface than the method of intermittent backwashing with air and feedwater method used with Memcor. A second factor may be differences in the surface characteristics of the two membrane materials (Memcor membrane is polypropylene; ZeeWeed membrane is proprietary and its material is not known).

As described previously, membrane cleanings conducted with Memcor in April were largely ineffective in reducing fouling. This is clearly illustrated in figure 5.3, where TMP was reduced only to between 10 and 12 psi (0.7 bar and 0.8 bar) after cleaning. In contrast, the more effective cleanings conducted on May 13 (after 721 hours of operation) reduced TMP to 8 psi (0.5 bar), much closer to the initial TMP of 5 psi (0.3 bar). The June 10 standard cleaning (after 1,370 hours of operation) reduced TMP to only 10 psi, again indicating that longer soak times, separate cleaning with citric acid, or both are required to achieve optimal results.

Feedwater Recovery. Figure 5.4 presents feedwater recovery data for the Memcor and ZeeWeed MF units during Phase I. Feedwater recovery achieved by the Memcor MF system was between 89 and 90 percent compared to greater than 96 percent for the ZeeWeed MF system during most of the test period. Expressed differently, ZeeWeed produced **less** than 50 percent of the waste flow generated by Memcor. In general, higher recovery is beneficial because it results in a greater availability of high quality water for reuse and potentially lower costs associated with conveyance and treatment





of the waste stream. ZeeWeed recovery decreased to approximately 94 percent after 1,350 hours of operation as filtrate flow rate decreased due to high TMP (vacuum).

Turbidity and SDI. The mean filtrate turbidity and **SDI** values presented in table 5.8 are well below the RO manufacturer's criteria of 0.2 NTU for turbidity and 3.0 for SDI, and are consistent with results obtained from other water reuse studies employing these technologies (Leslie, 1996). Such a result indirectly demonstrates that both ZeeWeed and. Memcor are capable of producing an effluent that can be efficiently processed by RO.

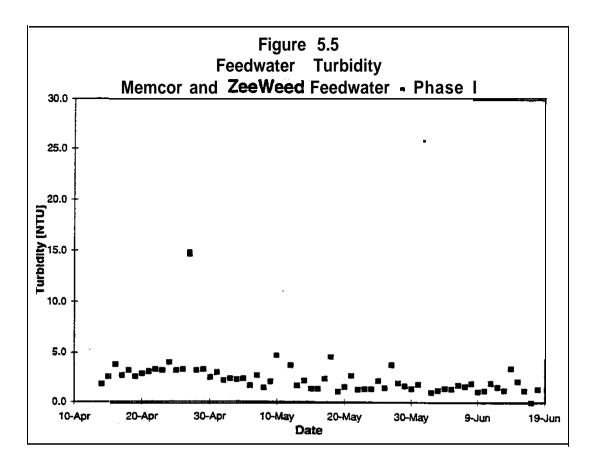
Turbidity values for the MF system feedwater (DDE) and filtrates are presented in figures 5.5 and 5.6, respectively. The data in figure 5.5 illustrate that, for the most part, DDE turbidity is consistently less than 5 NTU. For an unfiltered secondary effluent, this level of turbidity is typical, if not slightly **low**. On three occasions, DDE turbidity spiked to above **10** NTU.

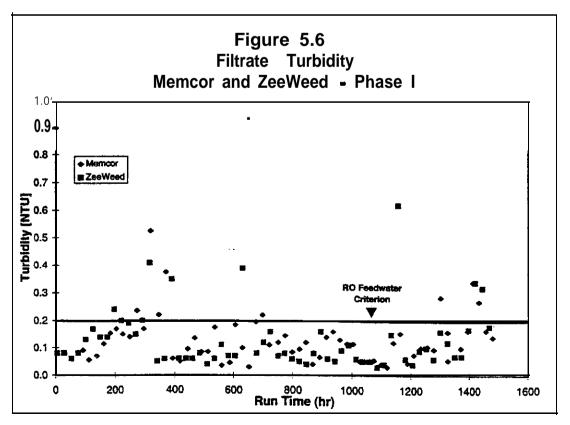
Manufacturers of the spiral-wound RO modules used for IPR recommend a maximum of 0.2 **NTU feedwater** turbidity to minimize RO membrane fouling and cleaning frequency. For the most part, Memcor and ZeeWeed filtrate turbidity was below this criterion, although spikes up to 1 NTU were observed. There is no clear explanation for this variability. Figure 5.6 does not indicate any trends in filtrate turbidity for either MF system during Phase I.

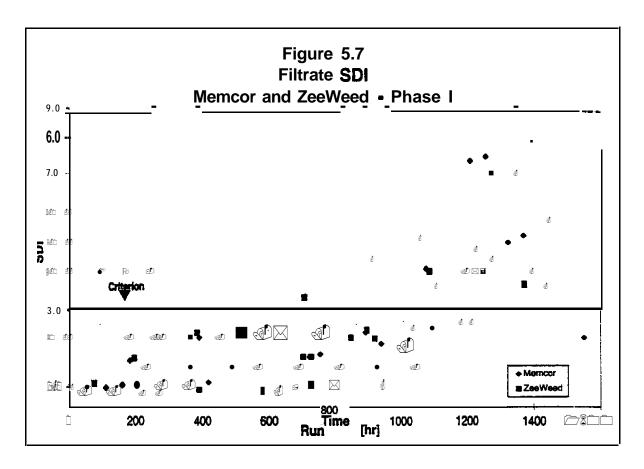
Phase I **SDI** results for the filtrate from each MF system are presented in figure 5.7. To better show trending, a moving average of the **SDI** values for each MF system is presented in figure 5.8. For the same reasons described for turbidity, RO manufacturers recommend that **SDI** for RO feedwater be less than or equal to 3. Although the results have significant variability (see table 5.8), nearly all values are less than 3 until the latter part of the test period. Figure 5.7 shows a slightly increasing trend in **SDI** values after 800 hours of operation. The increase was caused by the growth of algae in the translucent tubing used to sample filtrate from both units as well as in **the** translucent filtrate tubing and back flush tank used on the ZeeWeed tank. The **manufacturer** provided translucent tubing with the equipment. Algae growth continued unabated in these locations through the end of Phase 1 and into the beginning of Phase II. It was rectified on June 29.

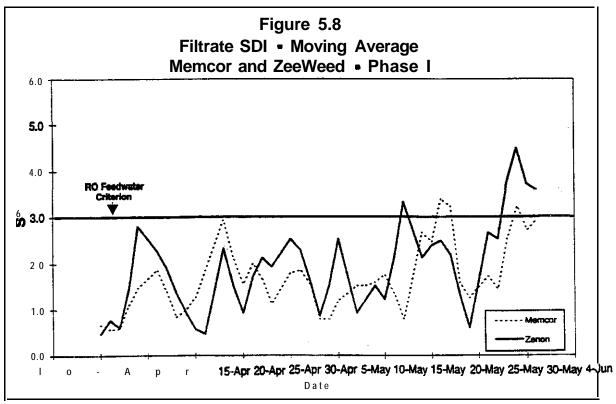
The author **did** not have previous experience with algal growth in wastewater reuse studies. **Consequently**, it **was** not recognized at the start of the study that the tubing would be problematic. The use of chlorinated water during ZeeWeed backwash would be expected to control this growth.

Particle Counts. No particle count data were collected during Phase I. Quantitative conclusions comparing ZeeWeed and Memcor MF operating and RO feedwater quality parameters are presented in Section 1.5.2.









5.3.4.2 Other Water Quality Parameters

Results for the following water quality parameters on the feedwater and MF system filtrates were presented in table 5.8 as mean, maximum, and minimum values:

Physical/chemical:TDS, conductivity, pHOrganics:Total Organic Carbon (TOC), color, ultraviolet absorbance at
253.7 nanometers (UVA-254)

Microbiological: Total and fecal coliforms, heterotrophic plate counts (HPCs)

The following conclusions can be drawn from an examination of the results:

- 1. Neither MF process reduces either the dissolved inorganic or organic content of the secondary effluent as measured by TDS and conductivity. This was the expected outcome as the pore size of the MF membranes is much larger than the dissolved ions and organic compounds present in the effluent.
- 2. The small reduction in apparent color provided by the two MF processes is most likely attributed to color generated from suspended matter that is filtered out during treatment. No true (i.e., dissolved) color removal would be expected.
- 3. It cannot be determined if the 15 percent difference in simulated distribution system (SDS) THM between the ZeeWeed filtrate and MF feedwater is significant. Only one sample was analyzed for the filtrates and thus no statistical analysis can be made regarding any apparent differences. No difference was observed between these two sources for either SDS HAA or UVA-254, which,along with SDS THM, are indirect measures of the amount of DBP precursor material.
- 4. During treatment with ZeeWeed, **pH** increases. The increase most likely results from the stripping of carbon dioxide from the secondary effluent by the aeration in the process tank.
- 5. ZeeWeed filtrate has consistently shown positive levels of both fecal and total coliforms whereas neither has been detected in the Memtec filtrate. Aerobic and facultative bacteria (as measured by the heterotrophic plate count method) are present in both filtrates; however, levels are greater in the ZeeWeed filtrate.

6. Control of suspended solids and algae is critical to successful performance **and** monitoring of the water treatment system.

The difference in nominal pore size between the Memcor membrane (0.2 pm) and ZeeWeed membrane (0.1 μ m) is not significant relative to the removal of the dissolved species or coliforms. The former are orders of magnitude smaller than this pore size range, while the latter can be effectively retained by a 0.45- μ m membrane filter.

Regarding conclusion (5), the ongoing presence of **coliforms** in the ZeeWeed filtrate is surprising, given that intact ZeeWeed membranes have pores too small to pass these and other bacteria. Two causes for this result can be hypothesized: (1) bacteria are "leaking" into the filtrate caused by one or more damaged fibers or seals in the module potted regions, or (2) there are significant dead legs in the filtrate piping that are allowing bacteria introduced through contamination of the piping to be proliferating. Integrity testing of the membrane module was conducted by **Zenon** at their factory prior to unit shipment so any leakage may have been caused by shipping or operation.

5.4 Phase II Testing

Phase II officially commenced with the beginning of operation of the ZeeWeed system on screened, de-gritted wastewater on June 19, 1997. Phase II testing continued through August 15, 1997.

As stated previously, during Phase II, the Memcor MF system continued to operate on DDE. However, for Phase II, the raw water supply piping to the ZeeWeed system was reconfigured to provide screened, de-gritted wastewater as the feedwater. The ZeeWeed system had two process functions for treating this source:

Biologically treat the screened, de-gritted wastewater to produce a "secondary effluent" meeting or exceeding the quality requirements of the City of McAllen (ZenoGem process). These requirements include producing an effluent that meets all the requirements of the City's NPDES permit for surface discharge.

From the perspective of RO feedwater, microfilter the "secondary effluent" to a quality equivalent to that produced by the Memcor and ZeeWeed MF systems treating secondary effluent (Phase I). The objectives for Phase II were:

Evaluate the ability of ZeeWeed MF, when used in conjunction with the ZenoGem process, to directly treat screened, de-gritted wastewater to a quality suitable for direct processing by RO, and compare ZenoGem filtrate quality to that of ZeeWeed and Memcor MF treated secondary effluent.

Compare the operating characteristics of the ZeeWeed MF when used:

- 1. To directly treat secondary effluent
- 2. In conjunction with the ZenoGem process to treat screened, de-gritted wastewater.

Compare the wastewater treatment efficiency of the ZenoGem process to that of extended aeration as performed at the McAllen WWTP by measuring the removal of CBOD,, TSS, and ammonia nitrogen.

The results from Phase II, including a comparison of the Phase I and Phase II results of the Memcor MF system and discussion of the results of the ZenoGem process, are presented in the following sections.

5.4.1 Memcor MF System Phase II Testing and Operations

Based on the lack of removal of dissolved constituents from the DDE by Memcor, it was decided that there was no real value to continue monitoring dissolved constituents in the Memcor feedwater during Phase I. Consequently, the following water quality parameters were measured only in the MF filtrate and not in the feedwater during this phase:

TDS Conductivity **pH** Color UVA absorbance @ 254 nm

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This section presents the results obtained during Phase II testing and compares Phase I operations of the Memcor MF system to Phase II operations. (It should be noted that the designations of Phase I and Phase II relative to the Memcor system operation are somewhat arbitrarybecause no real changes in feedwater source nor operation, other than flux changes, were instituted between phases.)

5.4.1.1 **Operations**

During Phase II, the Memcor MF system accumulated 1,297 hours of operation out of a possible 1,350 hours for an on-line factor of 0.96. The on-line factor is considerably higher for this phase because of the correction of operational issues in the beginning of Phase I that caused several downtimes.

During Phase II (June 24, July 17, and August 2), the system was removed from service by the pilot plant operator to reverse increases in TMP. TMP increased because solids from the modules fouled the membrane. The membrane was cleaned with Memclean EXA cleaning solution. As presented previously in table 5.6, the cleanings, which incorporated longer soak times, were effective in reducing TMP

At the end of Phase II, the Memcor MF unit was cleaned by **McAllen** WWTP personnel according to Memtec's requirements. The procedure followed is provided in appendix D.

5.4.1.2 Operating Conditions

Table 5.9 presents the Memcor operating criteria established for the Memcor **MF** system in the Research Work Plan and the values achieved for each phase of testing as well as for the combination of both phases.

					Actual	
Pa	arameter	Unit	Planned	Combined Phases I and II	Phase I only	Phase II only
Membrane	Flux	gfd'	26-30	20.2 - 27.0	20.2 - 27.0	23.8 • 26.6
Filtrate Flow		gpm	19.8 - 22.5	15.2 - 20.3	15.2-20.3	17.9-20.0
Transmem	brane Pressur	e psi	6 - 1 7	7.7 • 19.7	7.7-1 9.7	7.7-1 7.0
Back Wash	Pulse Frequency	minutes	15-20	20	20	20
Back Wash	/Pulse Duration	seconds	90	90	90	90
Back Wash/F Addition	Pulse Chemical	NA²	none	none	none	none
Cleaning	Frequency	days	3 - 5	15	14.2	15.8

Table 5.9.—Memcor Planned and Actual Operating Criteria Phase I and Phase II Operations

¹ gfd- gallons/square foot/day

² Not applicable

During both phases, the Memcor system operated at a lower than planned flux, although the flux was more consistent during Phase II. The cleaning intervals during Phase I were slightly shorter than during Phase II because of the unanticipated membrane fouling problems discussed previously.

For the combined testing period, the Memcor system operated at lower than planned flux but achieved a greater than planned interval-between-cleaning during the study. Additionally, the TMP had wider variations than planned because the manufacturer directed TMP be increased to maximum to compensate for a higher rate of fouling **during** Phase I. The lower-than-manned flux operation reflects the fouling problems **experienced** during Phase I.

5.4.2 Memcor MF System Phase I and Phase II Results

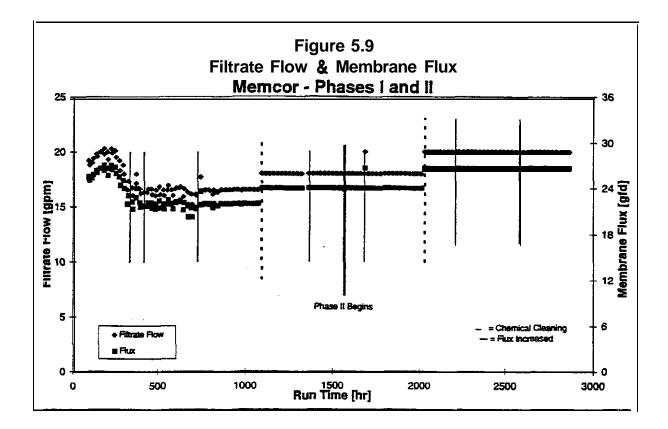
The operating and RO feedwater **quality** parameters for the Memcor MF system during Phase I and Phase II are discussed in the following sections.

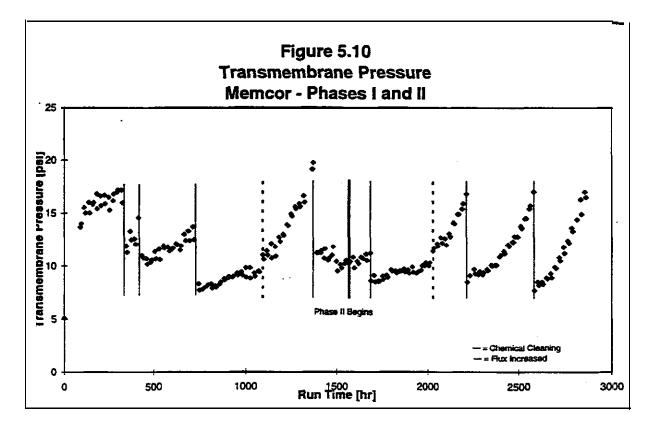
5.421 Operating and RO Feedwater Quality Parameters-Memcor Phases I and II

Filtrate Flow and Membrane Flux. Filtrate flow and membrane flux for the Memcor unit for Phases I and II are presented in figure 5.9. Phase II began at approximately 1,567 hours of operation. During the initial portion of Phase II, membrane flux was controlled at approximately 24 gfd ($40.8 \text{ L/m}^2/\text{hr}$) as established during the latter part of Phase I. At approximately 2,000 hours of operation, flux was increased to 26.6 gfd ($45.2 \text{ L/m}^2/\text{hr}$) to determine the effect of a higher solids loading on the rate of TMP increase and frequency of chemical cleanings. (The impacts of this change are discussed in the following section.)

The flux rate attained during Phase II is quite representative of the design flux rate determined for the Memcor process at other locations where the technology is being employed for RO pretreatment of secondary effluent (see table 5.10).

Transmembrane Pressure. Figure 5.10 presents the TMP for the Memcor MF system during Phases I and II. The plot shows that chemical cleanings implemented during Phase II were very effective for removing accumulated solids and restoring TMP to the target level of 7 to 8 psi (0.46 to 0.53 bar). It appears that the cleaning regime used during Phase II was capable of removing additional solids with each successful cleaning as evidenced by a slightly lower TMP after each cleaning.





Location	Flux (gfd)	Recovery (%)
McAllen	27	91
West Basin, California	27	9 1
Livermore, California	24	90
San Diego, California	28	92
WF-21, California	23	90

Table 5.10.--Comparison of Memcor Performance at McAllen with Performance at Other Sites

The best method of examining the impact of flux on membrane fouling rate is by calculating the rate of change in TMP with operating time. As shown in table 5.11, the average rate of TMP change for the three operating periods at 26.6 gfd ($45.2 \text{ L/m}^2/\text{hr}$) was 0.64 psi/day (4.47 kPa/day). This compares to an average rate of 0.31 psi/day (2.13 kPa/day) for operation at 24 gfd ($40.8 \text{ L/m}^2/\text{hr}$). This difference indicates that the Memcor process is quite sensitive to fouling in this flux range in that an 11 percent increase in flux resulted in a doubling of the fouling rate. If one were to assume each filtration cycle starts and ends at equivalent TMP values, operating at 26.6 gfd ($45.2 \text{ L/m}^2/\text{hr}$) should produce a 50 percent shorter filtration cycle. Operating intervals between cleanings shown in figure 5.10 do not reflect this difference clearly because cleanings at the lower flux were performed prior to terminal TMP (17 to 18 psi, or 1.1 to 1.2 bar).

Flux (gfd)	Operating Interval (hours)	Rate of TMP increase (psi/day)	Average Rate of TMP Increase (psi/day)	Comment
25.63	14.3	0.76	0.76	
22.33	3.2	0.84		
21.70	12.2	0.12		
22.04	15.0	0.18	0.38	No cleaning; average over previous 3 operating intervals (flux = 21.7 • 22.33)
23.97	12.0	0.73		Flux increased
23.96	13.0	0.00		
23.97	14.7	0.19	0.31	No cleaning: average over previous three operating intervals (flux = 23.97)
26.63	7.8	0.66		Flux increased
26.63	15.7	0.54		
26.63	12.0	0.73	0.64	Average over previous three operating intervals (flux = 26.63)

Table 5.11 .- Membrane Flux Rate and Associated Rate of TMP Change

Feedwater Recovery. Figure 5.11 presents feedwater recovery data for the Memcor MF system for Phases I and II. Recovery for the Memcor MF system during Phase I varied from a minimum of about 88 percent to a high of approximately 90 percent. However,

during Phase II, feedwater recovery was consistently at **90** percent until the filtrate flow was increased to 20 gpm (1.26 L/s), at which time the recovery rose to approximately 91 percent.

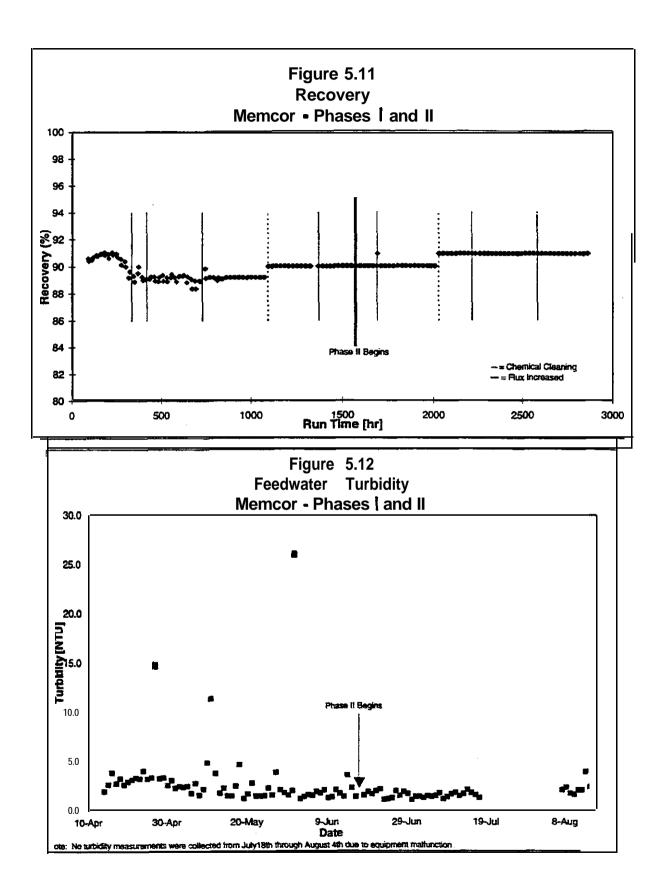
The increase in recovery at higher flux reflects a greater volume of filtrate produced per volume of backwash water generated. (Backwash frequency and volume were not changed during testing). In other words, recovery increases in proportion to flux given a constant backwash interval.

Turbidity and SDI. Combined Phase I and Phase II turbidity results for the Memcor system feedwater and filtrate are presented in figures 5.12 and 5.13, respectively. Filtrate **SDI** values for both phases are shown graphically in figure 5.14. Minimum, maximum, and average (mean) values for these parameters are presented in table 5.12. Turbidity and **SDI** results shown in table 5.12 represent combined data for both phases of testing. No turbidity values were collected between July 18 and August 4 because of a malfunction of the **McAllen** WWTP turbidimeter. Turbidity values reported for the period beginning August 5 through the end of testing were measured using a **Hach** 2100N portable turbidimeter provided by **CH2M** HILL.

Filtrate turbidity values from June 5 to June 29 are considered unrepresentative. Algae growth in the clear filtrate sampling tubing caused sample contamination during this period. The clear tubing was replaced with opaque tubing on June 29.

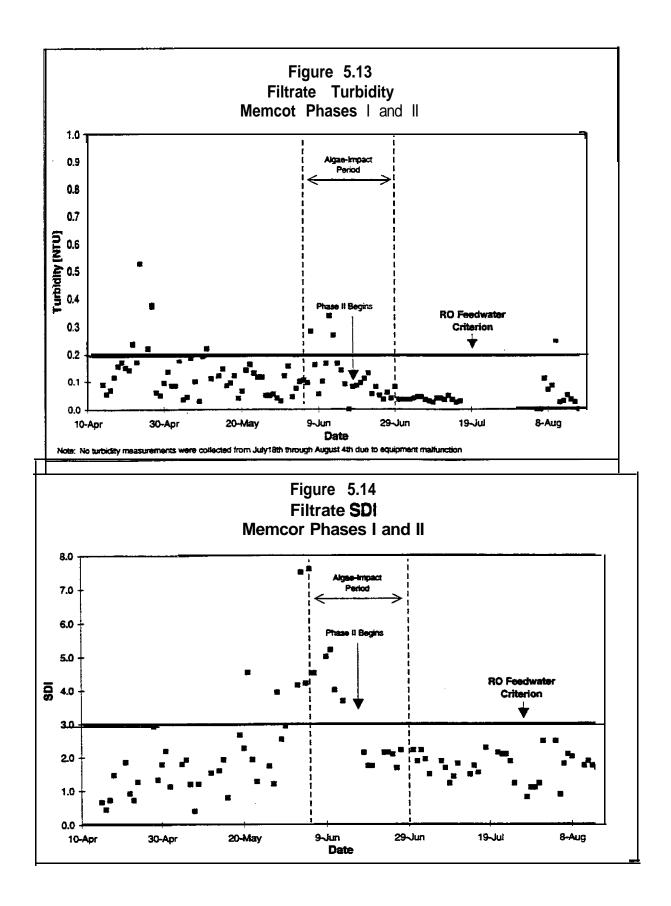
Feedwater turbidity during Phase II was similar to Phase I turbidity. Phase I and II mean turbidity levels were 0.12 and 0.05 NTU, respectively. Filtrate levels during Phase II were much less variable, reflecting the elimination of algal contamination from the filtrate sample line. Mean filtrate turbidity for Phase II was 0.05 NTU compared with 0.12 NTU for Phase I and was significantly less than the RO feedwater criterion of 0.2 **NTU**. It cannot be determined if algae growth prior to June 5 contributed to the increased variability in the turbidity data during Phase I.

Figure 5.14 presents the **SDI** values for the Memcor MF system during Phase I and Phase II. It is clear from figure 5.14 that algae growth in the filtrate sample line contributed to high **SDI** values. **SDI** filter pads from this period are greenish, whereas a light yellow hue is typical. Excluding data from the June 5 to 29 period, mean **SDI** values for Phase I and II were similar (2.02 versus 1.72). For the relevant period, nearly all results are lower than the RO feedwater criterion of 3.0.



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	lo. of	Sample!	Memcor Feedwater'			Memcor Filtrate'			
Parameter	Feed	Filtrate	Mean	Minimum	Maximur	Mean	Minimu	Maximu	
							m	m	
TDS (mg/L)	5	11	1,191	984	1,407	1,139	977	1,411	
Conductivity (µs/cm)	63	242 ⁵	1,970	1,520	2,500	1,789	755	2,410	
TOC (mg/L)	3	15	7.8	6.9	8.4	6.9	5.3	8.1	
Color (color units)	3	14	10.17	2.50	23.0	9.6	ND ^{2,3}	20.0	
UV Absorbance @ 254 (I/cm)	8	30	0.12	0.11	0.15	0.11	0.09	0.14	
SDS THM (µg/L)	2	2	325.4	317.4	333.7	317.4	310.3	324.4	
SDS HAA (µg/L)	2	2	123.4	119.4	127.4	129.5	128.3	130.6	
pН	63	121	7.06	6.87	7.41	7.09	6.86	8.16	
Turbidity (NTU)	103	206⁵	2.40	0.90	26.0	0.10	0.03	0.53	
TSS (mg/L)	20	18	2.6	0.8	8	0.3	0.2	1.0	
SDI	0	a2	NS⁴	NS	NS	2.11	0.40	7.60	
HPC (CFU/mi)	13	10	6,490	576	19,900	3,516	264	12,000	
Total Coliform (CFU/100 ml)	13	10	22	3	50	5	ND	15	
Fecal Coliform (CFU/100 ml)	13	10	23	2	59	ND	ND	ND	

Table 5.12.—Results for Primary and Secondary Water Quality Parameters Feedwater al Filtrate Quali for Memcor System Phas and Phase II

Phase I only for TDS, conductivity, pH, TOC, and color

² Phases I and II combined.

³ ND • Not Detected.

⁴ NS • Not Sampled.

⁵ Includes morning and afternoon samples. Average daily results were reported in spreadsheets.

5.4.2.2 Other Wafer Qualify Parameters

Additional testing results for other water quality parameters monitored for the Memcor system were presented in table 5.12 as mean, minimum, and maximum values. Table 5.12 contains combined Phase I and II results for the effluent from the Memcor MF system as well as the feedwater to the systems during Phase I and Phase II.

As described for Phase I, the Memcor system had little or no effect on the following dissolved constituents in the DDE: TDS, conductivity, UV absorbance at 254 nm, DBPs, and **pH**. On the average, Memcor reduced TOC by 10 percent, most likely removing the particulate portion of the organic carbon. Filtrate TSS levels were consistently lower than 1 NTU. As observed during Phase I, no fecal coliforms were detected in the filtrate. Total coliforms were detected on two occasions at 1 and 15 CFU/ml, however there was no trend in these results to indicate whether the **coliforms** passed the membrane or were a result of sample contamination. Pressure hold testing conducted with the Memcor system during this period showed no indication of membrane or module seal leakage. Taken together, these results are consistent with **performance** anticipated for a microfiltration process having a nominal membrane pore size of 0.2 microns in diameter.

5.4.3 ZenoGem Process Testing and Operations

Operating characteristics of the ZenoGem process that were monitored during **Phase** II include characteristics that were determined by monitoring feed and filtrate water, e.g., biological operating parameters and effluent water quality.

5.4.3.1 Commissioning and Operations

ZeeWeed unit commissioning was performed by the Zenon field technician on June 17 and 18, 1997. Commissioning included first seeding the process tank with return activated sludge from one of the WWTP clarifiers and then concentrating this material to approximately 12,000 mg/L mixed liquor suspended solids (MLSS) concentration. The unit began operation on screened, degritted wastewater with a filtrate flow of 7.5 Lpm and a vacuum of 3 inches of Hg to begin Phase II operation.

Official ZenoGem operation on screened, de-gritted wastewater commenced on June 19, 1997. From June 19 through August 14, the system accumulated 1,373 operating hours with no down time for an on-line factor of 1 (100 percent). No chemical cleanings were needed nor performed during this **9-week** period.

At the end of Phase II, the ZeeWeed MF module was cleaned by McAllen WWTP personnel according to the procedure provided by Zenon. A description of the procedure is presented in appendix D.

Results of Post-Phase II Chemical Cleanings

The procedure described in appendix C includes performing flux tests with clean (tap) water prior to and following each chemical cleaning to determine cleaning efficiency. The results of the flux tests, shown in table 5.13, show that a sequential cleaning, first with chlorine followed by acid, was needed to restore filtrate flow to levels observed prior to Phase II operation.

Activity	Filtrate Flow (gpm)	Vacuum (inches Hg)	Temperature (∘F)
Water flux before cleaning	1.75	10	83
Clean water flux after first NaOCI cleaning	4.4	10	88
Clean water flux during HCI cleaning	5.50	10	89
Clean water flux after second NaOCI cleaning	4.50	10	85

Table 5.13.—Results of Final ZeeWeed Cleaning

5.4.3.2 ZenoGem Process MF Operating Conditions

Table 5.14 presents the operating criteria that were established for the ZeeWeed MF portion of the ZenoGem process. Table 5.14 also presents the values that were achieved for these criteria during Phase II. Plots of MF filtrate flow, flux, TMP, and recovery, all as a function of operating time, are presented in this subsection.

Performance of the ZeeWeed MF module conformed to planned levels for the above criteria, with some exceptions, as discussed below:

Filtrate Flow and Membrane Flux - Target flow and flux for ZeeWeed module operation during Phase II were reduced to 2 gpm (0.13 L/s) and 20 gfd (34.0 $L/m^2/hr$) respectively, based on the high solids levels present in the bioreactor. These levels were maintained more than 90 percent of the time. Excursions were caused by a vacuum pressure switch on the filtrate header.

Zeevveed MF							
Parameter'	Unit	Planned	Actual				
Filtrate Flow	gpm	2.1 • 4.2	1.6-3.2				
Transmembrane Pressure	psi	3 - 9	1.5-5.2				
Membrane Flux	gfd ²	20-40	15.2 -30.4				
Back Wash/Pulse Frequency	minutes	6-12	10-20				
Back Wash/Pulse Duration	seconds	10	10-20				
Back Wash/Pulse Chemical Addition	NA ³	chlorine	none				
Cleaning Frequency	days	20-30	>45				

Table	5.14.—	-Planned	and	Actual	Operating	Criteria	٠	ZenoGem	Phase	Ш

1 TMP and cleaning frequency are dependent variables; the remainder are control variables

2 gfd - gallons/square foot/day

3 Not applicable

Filtrate Flow and Membrane Flux. Plots of filtrate flow and membrane flux as a function of operating time for both phases of ZeeWeed operation are presented in figures 5.15 and 5.16. The filtrate flow and membrane flux were fairly stable during each phase of operation. However, the flow and flux did begin to decrease at the end of Phase II. Additionally, flow and flux were approximately 1.4 times higher during Phase I.

Transmembrane Pressure. TMP for the ZeeWeed MF module during each phase of operation is presented in figure 5.17. The rate of TMP increase over time was significantly lower during Phase II. Average rate of increase was 0.068 psi/day (0.47 **kPa/day**) for Phase I versus 0.056 psi/day (0.39 **kPa/day**) for Phase II. These **results** indicate a lower rate of membrane fouling when filtering the high concentration of biological solids (>10,000 mg/L) versus filtration of low solids (<10 mg/L) present in the DDE. The lower rate may be the result of either or both of the following:

A lower rate of solids loading at the surface of the membrane (lower flux)

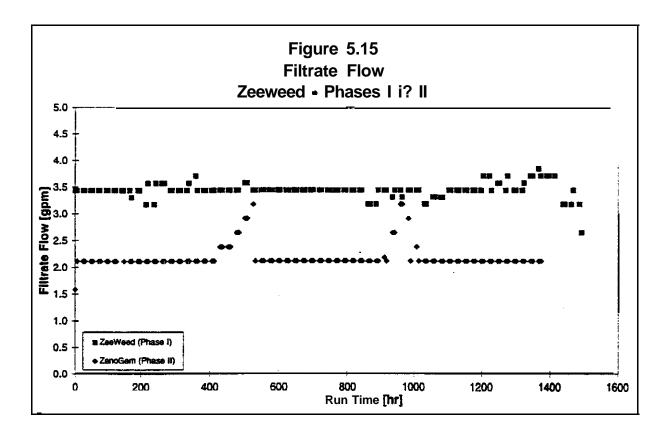
A greater degree of mechanical cleaning of the membrane surface provided by the higher solids level.

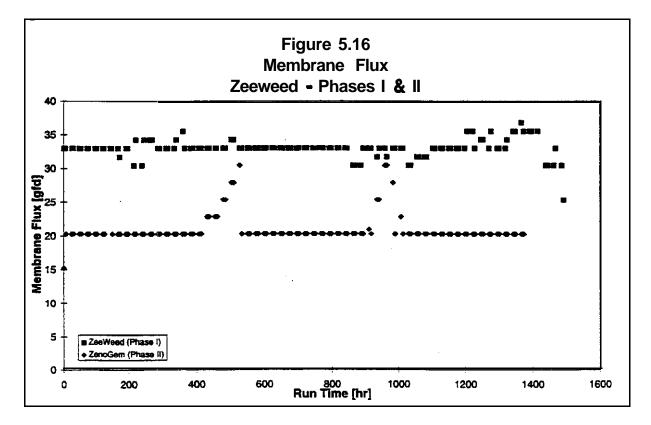
Recovery. Figure 5.18 presents feedwater recovery for the ZeeWeed MF system during each phase of testing. The higher recovery achieved during Phase II (>99 percent) was a direct outcome of maintaining the desired solids retention time necessary for **biological** treatment (See section 5.4.4.1 for a discussion of SRT.) Phase II recovery was approximately 2 to 4 percent higher than that observed during Phase I. Additionally, Phase II recovery was very consistent, while Phase I recoveries were more variable and began a sharp decrease toward the end of Phase I testing.

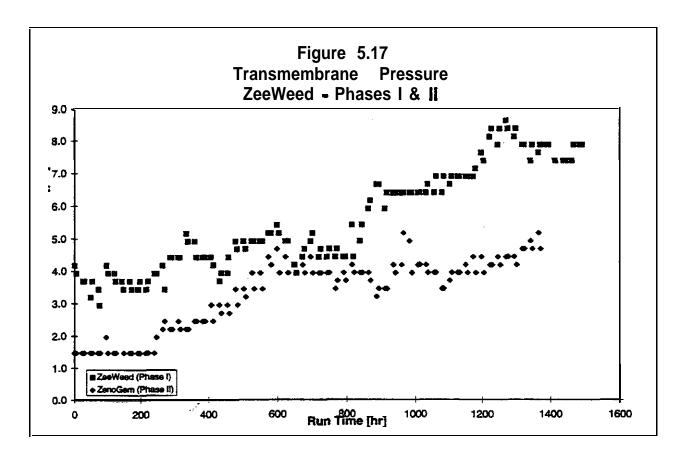
Turbidity and SDI. Figures 5.19 and 5.20 present filtrate turbidity and SDI, respectively, for both phases of testing. Turbidity was higher during Phase II, with an average of 0.18 NTU versus 0.13 NTU for Phase I. Although the average turbidity values were below the recommended value of 0.2 **NTU**, some values were above 0.2 NTU in each phase. Phase I **SDI** values **were** much lower than those obtained during Phase II. Average **SDI** during Phase I was 1.92 compared to 5.02 for Phase II.

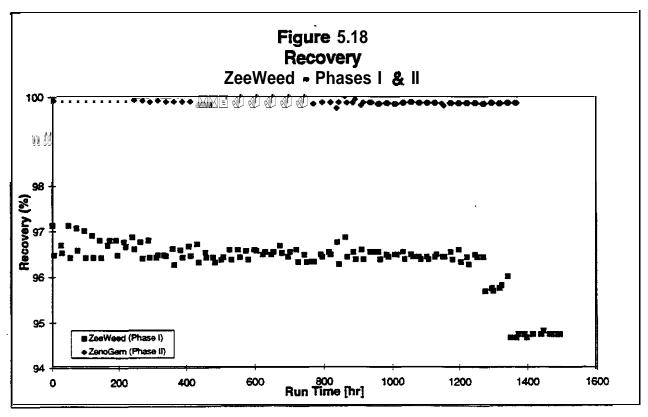
TMP • The ZeeWeed MF module had an initial TMP of 1.5 psi (0.1 bar) during Phase II compared to an anticipated minimum of 3 psi (0.2 bar). The lower initial TMP directly reflects lower resistance of the membrane to water flow at the lower flux used during Phase II (Phase I was operated at 33 gfd [56.0 $L/m^2/hr$] average flux).

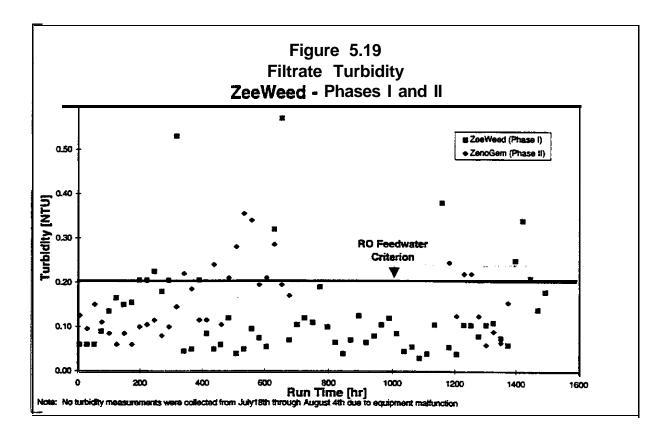
Back Pulse Characteristics (frequency, duration, and chemical use) - Following discussions with **Zenon**, operating values were established in the research work plan. These values were later modified. As described for Phase I, the changes reflect **the** approach of not chlorinating the back pulse fluid to minimize DBP formation and **com**-pensating for the absence of a disinfectant by increasing duration of backpulse flow.

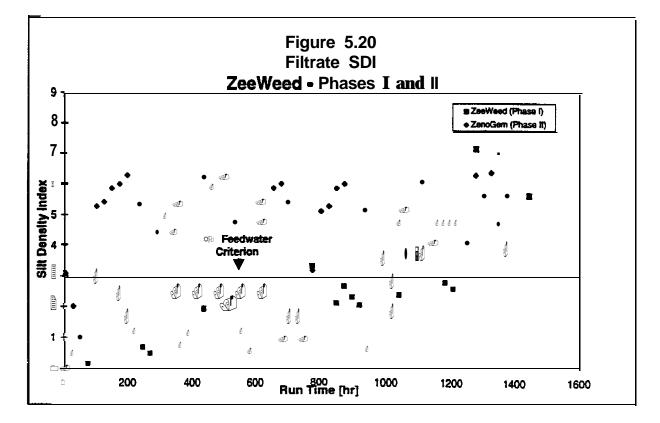












5.4.3.3 ZenoGem Process Biological Treatment Operating Conditions

Operating criteria established for the biological treatment portion of the ZenoGem process, along with the values that were achieved during the reporting period, are presented in table 5.15.

20100		hase n	
Parameter	Unit	Planned	Actual
MLVSS	mg/L	10,000	8,900 - 14,033
Dissolved Oxygen	mg/L	>2	0.5 - 4.60
Hydraulic Retention Time	days	24	2.92 - 5.84

Table 5.15.—Planned and Actual Biological Treatment Operating Criteria ZenoGem Process • Phase II

The target MLVSS concentration was 10,000 mg/L. The average MLVSS was 11,400 mg/L. The high degree of variability in MLVSS levels reflects the imprecision of controlling this parameter through the daily measurement of MLSS levels and adjusted sludge **blowdown** volume based on a single MLSS result. Target HRT was 2 to 4 hours. The actual operating range was 2.9 to 5.8 hours. The HRT was controlled at 2.9 hours for all but the last 10 days of operation when it was increased to improve nitrification efficiency.

5.4.4 Comparison of ZenoGem and McAllen WWTP Performance

The wastewater treatment performance of the ZenoGem system and McAllen WWTP No. 2 was compared to assess relative efficiency of the two processes. The WWTP employs extended aeration using surface aerators. As is typical for most conventional design wastewater plants, activated sludge is removed from the aeration basin and a portion is recycled back to the aeration basin as return activated sludge (**RAS**) to maintain the desired level of biological solids (**MLVSS**). The remainder is wasted from the system (waste activated sludge or WAS) to sludge drying beds. Operating characteristics and related water quality parameters for ZenoGem and WWTP are presented and discussed in the following sections.

5.4.4.1 Biological Treatment Operating Characteristics

Table 5.16 presents biological treatment operating characteristics for both processes. Data from the McAllen WWTP was obtained from the plant sludge control logs for the east aeration basin during the Phase II testing period.

	Zeno	Gem Biore	actor	WWTP E	East Aeratio	on Basin
Parameter	Mean	Min	Max	Mean	Min	Max
Dissolved Oxygen (mg/L)	2.62	0.50	4.60	2.65	1.40	4.00
MLSS (mg/L)	15,119	12,300	19,400	3241	2620	4000
MLVSS (mg/L)	11,022	8,900	14,033	2333	1840	2980
Hydraulic Retention Time (hr)	3.61	2.92	5.84	29.8	23.0	37.0
Solids Retention Time (days)	16.4	10.3	26.4	12.4	5.00	23.0
Oxygen Uptake Rate (mg/L-hr)	36.9	7.80	89.4	NAa	NA	NA
Sludge Yield (g/g)	0.74	NC ^b	NC	0.73	NC	NC

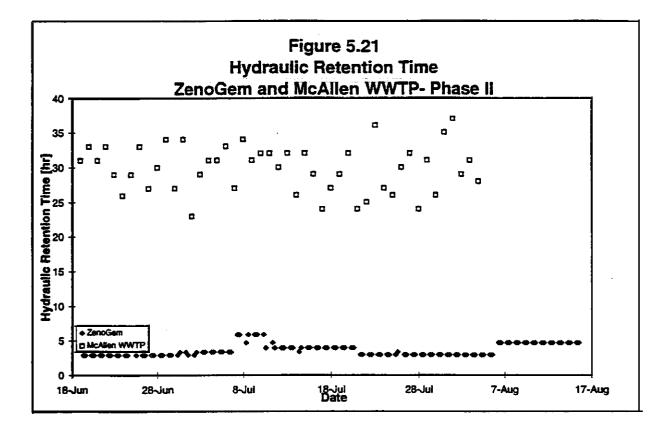
Table 5.1 &--Biological Treatment Operating Characteristics ZenoGem Process and City of McAllen WWTP

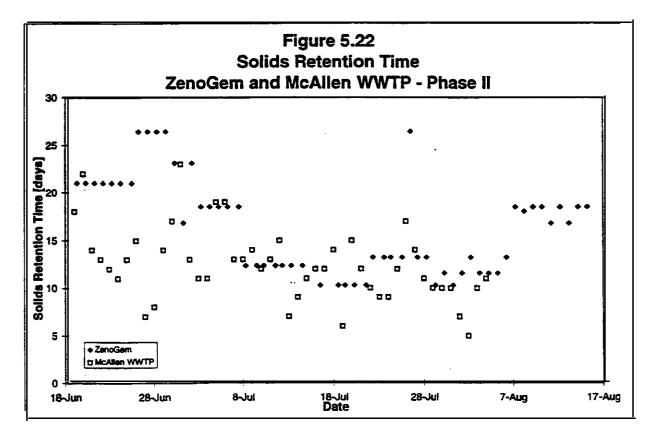
a NA • Information not available. b NC • Not calculated

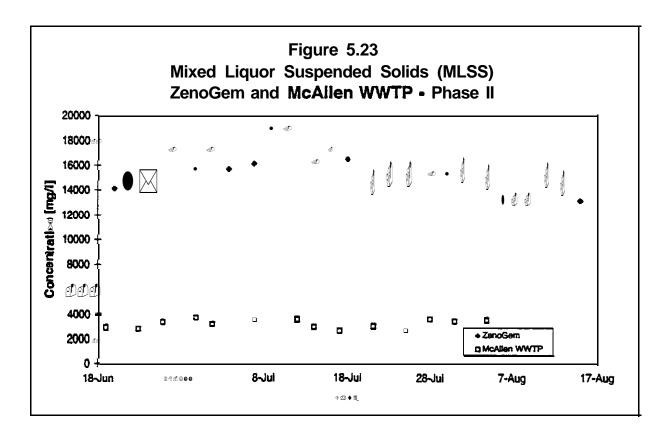
Hydraulic and Solids Retention Time. Figures 5.21 and 5.22 present the hydraulic and solids retention time, respectively, for the ZenoGem bioreactor and the McAllen WWTP during Phase II. The data in figure 18 indicate that the ZenoGem process was consistently operated at much lower HRT than the WWTP. The average HRT for the ZenoGem process was 3.6 hours compared with 30 hrs for the aeration basins. The ZenoGem process can operate at the much shorter HRT because the greater concentration of microorganisms assimilate and reduce the BOD of the wastewater at a much more rapid rate. SRT levels in the two processes were comparable. The average SRT of 13 hours for the WWTP is at the low range of values representative for extended aeration plants (15 to 30 days). The ZenoGem process has the capability to be operated with longer SRT than conventional wastewater processes because it is not limited by sludge bulking that typically occurs at very long detention times.

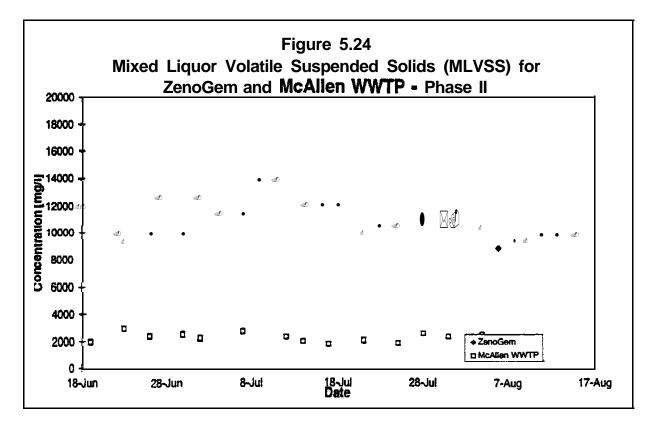
Mixed Liquor Suspended and Volatile Suspended Solids. The McAllen WWTP and the ZenoGem system use the suspended growth process (activated sludge) to achieve biological treatment. Removal of carbonaceous organic matter in a suspended growth process depends directly on the concentration of bacteria present in the mixed liquor (activated sludge). Bacterial levels can be estimated by measuring the concentration of either the MLVSS or MISS in the treatment reactor. The latter is more practical for maintaining proper bacterial levels because it is an easier and more rapid method. MLVSS is a more accurate measure of bacterial content because it excludes the inert fraction of the suspended solids; however, it requires an additional drying and weighing step, which adds time and effort. MLVSS levels can be estimated from MLSS measurements. A ratio of 0.7 to 0.9 for MLVSS to MISS is typical.

MLSS and MLVSS levels measured in the ZenoGem bioreactor tank and the WWTP east aeration basin are shown in figures 5.23 and 5.24, respectively, as a function of calendar date during Phase II. It is clear from the figures that, as designed, bacterial levels were **maintained** at significantly higher levels in the ZenoGem process than in









the WWTP. Average MLVSS concentration for ZenoGem was 11,000 mg/L compared to 2,300 mg/L for the WWTP, or a factor of 4.8 higher for ZenoGem. The most common range of MLVSS values for conventional air activated sludge systems is 2,000 to 2,500 mg/L (Water Environment Federation, 1991). Although air based conventional syntems can operate at somewhat higher MLVSS levels (up to 3,000 mg/L in practice), sludge settleability decreases as levels decrease. Settleability is not an issue for the ZenoGem process because separation does not depend on gravity but rather on the ZeeWeed membrane.

The significance of the greater MLVSS levels is that the ability to remove $CBOD_3$ is directly proportional to bacterial density in the activated sludge tank (or bioreactor). By maintaining higher MLVSS concentrations, the ZenoGem process can attain comparable reduction in BOD, at a much lower hydraulic detention time for the bacterial cells (mean cell residence time). This is clearly illustrated in table 5.16, where the average HRT for ZenoGem is 3.61 hours versus 29.8 hours for the WWTP. In other words, the same degree of treatment can be accomplished in roughly one-tenth of the time or volume needed by the extended aeration process used at McAllen. Assuming similar depths for an aeration basin and ZenoGem bioreactor, the tankage area of the ZenoGem process would require only 10 percent of the land area required for the extended aeration basins.

The ratio of MLVSS to MLSS for ZenoGem and the WWTP was 0.73 and 0.72, respectively. This is at the lower end of the typical range and reflects the lack of inert settling in primary treatment, which was not employed with either process evaluated.

Dissolved Oxygen. Proper dissolved oxygen (DO) levels must be maintained in the activated sludge process to enable efficient degradation of both carbonaceous organic matter and organic nitrogen. Generally, DO levels in the activated sludge process should be maintained around 2.0 mg/L or greater to ensure that sufficient oxygen is present to achieve effective BOD5 removal and nitrification (Water Environment Federation, 1990). Lower levels will impede nitrification.

DO levels, as measured in the two treatment systems during Phase II, are presented in figure 5.25. DO levels in the aeration basin were generally maintained between 1.5 and 3.5 mg/L, where both carbonaceous and nitrogenous BOD removal was desired and achieved. For ZenoGem, DO levels were typically greater than 2 mg/L except during the initial period of operation (from June through July 3, 1997) when the pilot plant blower was set to deliver insufficient air flow. Air delivery levels were increased on July 3, from 8 to 10 cubic feet per minute (cfm). As discussed later in this section, the lower initial DO levels for the ZenoGem system caused reduced ammonia removal. During the entire Phase II period, average DO contents for ZenoGem and the WWTP were similar (2.62 mg/L for ZenoGem versus 2.65 mg/L for the WWTP).

Oxygen Uptake Rate. Oxygen uptake rates in the ZenoGem bioreactor were generally greater than 40 mg/L-hr. The oxygen uptake rates and the excellent BOD5 removals that were achieved indicate good biological activity.

Sludge Yield. Sludge yield coefficient, Y, is a measure of the amount of biological solids produced by a wastewater treatment process relative to the amount of organic matter removed. Ideally, the sludge yield should be as low as possible to minimize the need to dispose of sludge. For the extended aeration process used at the WWTP, Y is typically low because the microorganisms in the activated sludge operate in the endogenous phase based on the long mean cell residence time (SRT) of this type of system. Y values for the ZenoGem system should be comparable to those for the WWTP because both operated at similar SRTs. The average sludge yield for the ZenoGem process was 0.74 g of sludge produced per gram of CBOD5 removed. This value is less than the typical value for activated sludge systems and suggests that the long SRTs used in this study reduced sludge production. An accurate determination of sludge yield for the ZenoGem process a longer operating period than was employed in this study. Based on the data available from the McAllen WWTP control logs,, sludge yield for the McAllen WWTP was 0.73. This is comparable to that obtained for the ZenoGem process.

5.4.4.2 Biological Treatment Water Quality Parameters

Several water quality parameters were measured to monitor the effectiveness of the biological treatment portion of the ZenoGem process and the McAllen WWTP. Each of these parameters is presented in table 5.17 as a mean, minimum, and maximum value and is discussed below.

Carbonaceous Biochemical Oxygen Demand (CBOD,). Reduction in CBOD, levels across the biological treatment process is used to evaluate the efficiency of the activated sludge process for reducing the level of organic matter in the raw waste-water. (**BOD**₅ is also used to measure treatment efficiency; however, it includes both carbonaceous and nitrogenous BOD.) Figure 5.26 presents the **CBOD**₅ results for ZenoGem filtrate and WWTP effluent, during Phase II. (Filtrate/effluent levels are shown in lieu of percent **CBOD**₅ removal because influent CBOD, concentrations to each process were assumed to be equivalent.) The following can be concluded from the data in table 5.17 and figure 5.26:

• The ZenoGem process produced a filtrate having a CBOD, consistently below 1 mg/L.

The ZenoGem process was more efficient at removing CBOD, from the raw wastewater than was the WWTP, despite operating with one-tenth the hydraulic retention time.

The ZenoGem process is more than capable of producing an effluent meeting McAllen's current effluent discharge limit of 15 mg/L CBOD,.

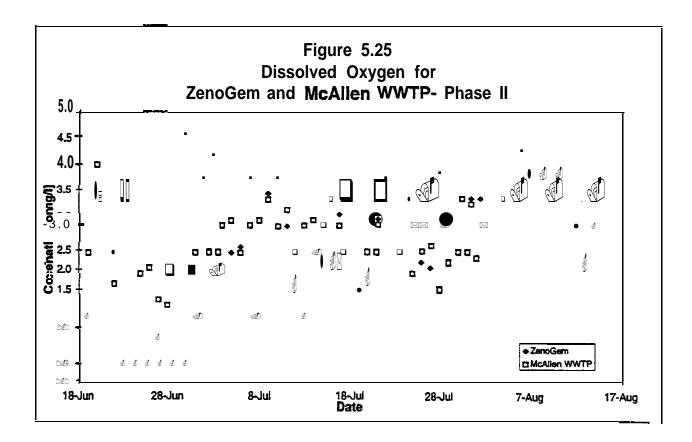
Total Suspended Solids (TSS). As anticipated and as shown in table 5.17, TSS concentrations in the ZenoGem filtrate were less than or equal to 1.0 mg/L throughout the

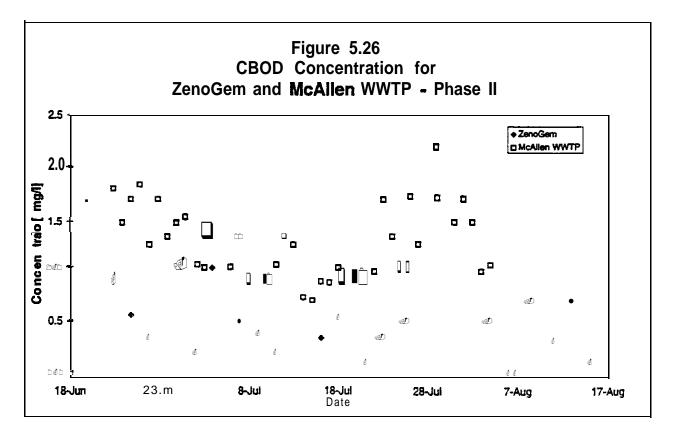
TABLE 5.17 Biological Treatment Waler Quality Parameters ZenoGem Process. Phase II

	No. of d	ata values c	Fa (D	Gem/W edwate e-gritte stewate	r" d	ZenoGem Filtrate			WWTP Effluent			
	Feed	ZenoGem	WWTP	Mean	Min	Max	Mean	Min	Man	Mean	Min	Max
Ammonia Nitrogen (mg/L)	16	2 2	54	27.0	22.9	32.9	3.08	0.04	18.8	0.24	0.01	1.5
TKN (mg/L)	9	9	0	63.1	2.00	109	8.3	1.30	20.8	NS ^b	NS	NS
Nitrite and Nitrate Nitrogen (mg/L)	9	9	0	0.74	0.02	2.94	8.06	0.01	19.10	NS	NS	NS
Tolal Phosphorus (mg/L)	: 9	9	0	11.3	0.12	41.0	2.02	0.05	7.00	NS	NS	NS
CBOD _s (mg/L)	58	2 2	54	189	132	679	0.55	0.04	1.63	1.32	0.78	2.2
Total Suspended Solids	46	8	0	203	116	473	0.6	0.2	1.0	NS	NS	NS

A Notes: Data for ammonia nitrogen, TSS and CBOD5 from City of McAllen WWTP routine sampling.

^bNS . Not Sampled





Phase II period and well below the regulatory discharge limit of 5 mg/L. TSS levels in the WWTP are not presented; however, they typically range from 1 to 4 mg/L, higher than in the ZenoGem filtrate.

Nitrogen Species. Figure 5.27 presents ammonia nitrogen concentrations for the **ZenoGem**/ WWTP **influent**, ZenoGem filtrate and **WWTP** effluent. The WWTP achieved nearly complete nitrification during the test period (mean ammonia nitrogen concentration was 0.24 mg/L). In contrast, nitrification was not complete during most of ZenoGem unit operation and ammonia nitrogen levels in the ZenoGem filtrate did not reach similarly low levels until the last two weeks of operation. Incomplete nitrification was the result of two factors:

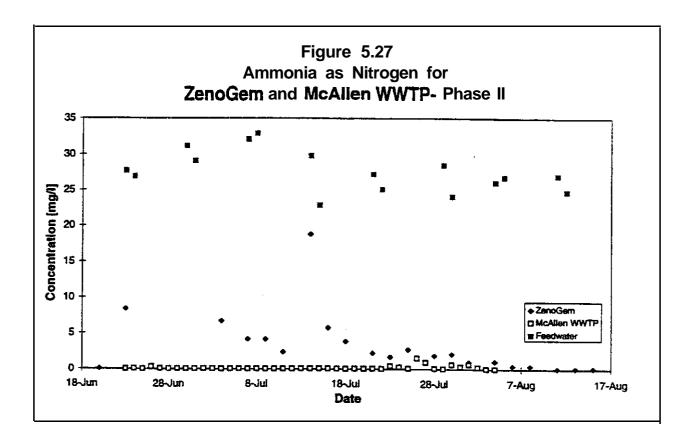
During the first 3 weeks of operation, DO levels in the bioreactor tank were insufficient (generally less than 2 mg/L).

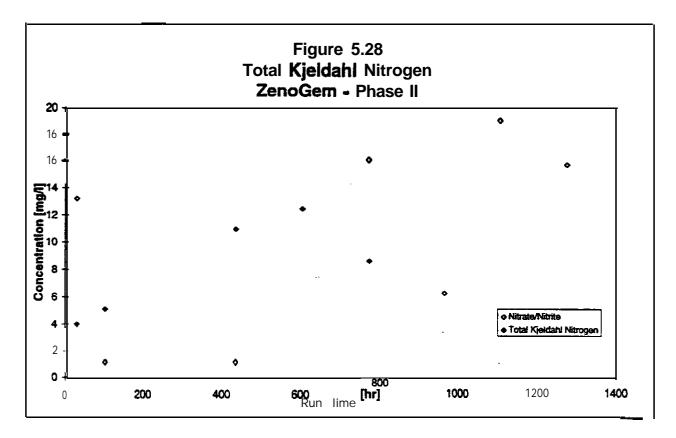
During the period July 9 through August 5, DO levels were in the appropriate range; however, **nitrification** was less than complete and **was** limited by the ability to transfer sufficient oxygen from the bulk fluid to the organisms within the **flocs**. This was caused by low solubility of oxygen at the temperatures in the bioreactor (85 to 95 \circ F). When bioreactor HRT was increased from 2.9 to 4.7 hours on August 6 (effectively reducing oxygen demand by the **nitrifiers**), ammonia levels decreased to <0.2 mg/L.

Total **Kjeldahl** nitrogen (**TKN**) and nitrate/nitrite levels in the ZenoGem filtrate are shown in figure 5.28. TKN levels were elevated during the **first** half of testing but decreased steadily to near zero by the last week of operation. In contrast, inorganic nitrogen levels in the filtrate were very low during the first half of testing but **increased** to nearly 20 **mg/L** during the latter part of operation. These results are consistent with the earlier observation that **nitrification** was inhibited during the early periods of testing, improved dramatically as DO levels were increased and was optimum when DO levels were sufficient and HRT was reduced.

Nitrification Rate. Nitrification rates were **calculated** for the ZenoGem process and the **McAllen** WWTP. Assuming an average water temperature of 31 degrees Celsius (observed during the Phase II activities) and a **nitrifier** fraction of 0.054 (based on the **BOD/TKN** ratio), the specific **nitrification** rate for the ZenoGem process and the **McAllen** WWTP were 0.26 g NH,-N/g NVSS and 0.17 NH,-N/g NVSS.

Total Phosphorus. A comparison of phosphorus removal by the two treatment processes was not made during the study. There is no phosphorus limit imposed on discharge of effluent by the WWTP. On average, the ZenoGem process removed 76% of the phosphorus from the raw wastewater to about 2 mg/L. This level is typical for wastewater treatment plants using the activated sludge process where no chemical precipitation of phosphorus is practiced. Zenon is currently operating the ZenoGem process at selected locations to achieve phosphorus levels below 0.1 mg/L using alum as a precipitant (Lozier, 1997a).





5.4.4.3 Conclusions

ZenoGem can treat McAllen's raw wastewater to a quality comparable to the City's existing WWTP effluent more efficiently than the existing WWTP. By operating the activated sludge process at an average mixed liquor volatile suspended solids (MLVSS) concentration of 11,000 mg/L and at solids retention times of 3 to 5 hours, ZenoGem requires only one-tenth the hydraulic retention time, or "footprint," to achieve the same degree of BOD_5 and ammonia removal as the existing WWTP. The WTTP operates with an average MLVSS concentration of 2,333 mg/L and a hydraulic retention time of 29.8 hours. The nitritication rate for the ZenoGem process was 0.26 g NH₃-N/g nitrified volatile suspended solids (NVSS)-day compared to 0.17 g NH₃-N/g NVSS-day for the McAllen WWTP.

5.4.5 ZenoGem Process vs. ZeeWeed MF System

This section compares the operating characteristics of the ZeeWeed membrane used to directly **filter** secondary effluent to its use as part of the ZenoGem system. Such a comparison allows a determination of (1) the relative economics of ZeeWeed operation under the two treatment scenarios and (2) whether filtrate quality from ZenoGem operation is comparable relative to quality requirements for the RO process.

5.4.5.1 Treatment Economics

Filtrate flow and membrane flux were presented in figures 5.15 and 5.16, respectively, for the ZeeWeed MF system during Phase I and during Phase II. Flow and flux, both control variables during the study, were approximately 67 percent higher for ZeeWeed operation on secondary effluent. Flow and flux were controlled at the indicated levels based on **Zenon's** experience with their MF process operating on the two different feedstreams. This resulted in the ZeeWeed unit operating at 67 percent higher flux on secondary effluent, translating into a substantially greater capital cost for ZeeWeed for raw wastewater treatment. However, this cost difference could be mitigated by **the** following factors:

Where new wastewater and reuse facilities are needed, ZenoGem could be used in place of both primary and secondary treatments as well as MF treatment of the secondary effluent.

Where an existing wastewater treatment plant uses concrete structures for either suspended growth secondary treatment and/or activated sludge clarification, the ZeeWeed modules can be installed directly into these structures (for the ZenoGem process), thereby deferring the cost of building new basins or tanks to house the modules as would be required for ZeeWeed MF of secondary effluent. Further, the lower rate of membrane fouling experienced during Phase II operation (see figure 5.17) suggests that the ZeeWeed modules can be operated at a higher flux to provided comparable cycle times between chemical cleanings. (Conversely, the modules could be **operated** at lower flux rates when treating secondary effluent to provide comparable cycles.) This would further mitigate capital cost differences.

5.4.5.2 RO Feedwater Quality

Figures 5.19 and 5.20 presented a comparison of filtrate turbidity and SDI for ZeeWeed operation during the two phases. Statistical information on these parameters is also presented in table 5.18; data values were excluded for the latter part of Phase I where ZeeWeed filtrate quality was adversely impacted by algal growth in the filtrate piping and sample lines. No turbidity values were collected between July 17 and August 4 (Phase II) because of a malfunction of the McAllen WWTP turbidimeter. Filtrate turbidity values were generally comparable for the two phases, with ZenoGem filtrate having a slightly higher mean (0.13 NTU for Phase I versus 0.16 NTU for Phase II.) However, ZenoGem filtrate turbidity levels were consistently lower than the 0.2 NTU RO feedwater criterion. The minimal turbidity difference underscores the ability of the ZeeWeed membrane to act as a physical barrier to solids, given that the concentration of solids on the feed side of the membranes averaged 15,000 mg/L during Phase II versus 3.6 mg/L during Phase I.

In contrast, filtrate **SDI** values for Phase II were significantly and consistently higher than during Phase I. Mean **SDIs** were 5.0 and 2.6, respectively. The data in figure 5.20 show a trend of increasing values for Phase I after 1,000 hours. As discussed previously, however, the increases were caused by increased particle loading from algal growth and sloughing in the filtrate piping and sampling lines and are not considered representative. If values from 1,000 hours onward are excluded, the mean **SDI** for Phase I is 1.6. No trending was evident for Phase II filtrate, hence the mean value of 5.0.

Theoretically, there should be no particles present in the ZenoGem filtrate large enough' to cause fouling of the 0.45-µm nominal pore size SDI filter pad. It is hypothesized, instead, that the observed differences in SDI values is a function of differences in the content and level of large molecular weight, ionized, organic compounds adsorbed onto the SDI filter pad causing pore blocking and a reduction in flow through the SDI filter. The amount of these compounds appears to be a function of SRT in the ZenoGem bioreactor. Research conducted at Orange County Water District's Water Factory 21 (WF-21) and the Sanitation District of Orange County, California, support this hypothesis (Lozier, 1997b). SDIs greater than 5 were observed during ZenoGem operation on primary effluent when SRTs were greater than 5 days.

¹ larger than 0.2 microns in diameter

	No. Of	Samples	ZeeWee	d MF Filtrat	ie (Phase I)	ZenoG	em Filtrate	(Phase II)	
Parameter	ZeeWeed	ZenoGem	Mean	Min	Max	Mean	Min	Max	
TDS(mg/L)	4	4	1,216	975	1,410	943	861	1,022	
conductivity (us/cm)	63	18	2.027	1.575	2.525	1,532	1,320	1,700	
FOC(mg/L)	6	6	7.4	6.7	8.1	7.7	6.6	9.3	
Color (color units)	5	6	7.6	0.0	15.0	17.6	10.0	25.0	
JV Absorbance @ 254 (I/cm)	12	16	0.120	0.106	0.142	0.14	0.11	0.16	
SDS THM (mg/L)	1	2	269.4	269.4	269.4	21.9	21.9	21.9	
SDS HAA (mg/L)	1	2	127.0	127.0	127.0	56.7	56.7	56.7	
⊎H (""its,	63	59	6.07	6.97	6.36	7.34	6.90	7.77	
urbidity (NTU)	63	6 2	0.13	0.03	0.57	0.16	0.06	0.36	
DI	41	43	2.55	0.13	6.10	4.99	1.67	6.40	
IPC (CFU/ml)	3	6	3.215	400	13,000	6.125	1,500	11,200	
otal Coliform (CFU/100 mI)	3	7	6	1	16	7	3	11	
Fecal Coliform (CFU/100 ml)	3	7	14	1	44	3	1	7	

Table 5,18.—Water Quality Parameters ZeeWeed Phase I and ZenoGem Phase II

At the Sanitation District of Orange County, ZenoGem operation on the same primary effluent at **SRTs** less than 5 have produced filtrate **SDIs** less than 2. Additional testing at WF-21 showed that as the SRT was allowed to increase, the **SDI** values increased. Although **SDI** values from ZenoGem operation were greater than the RO feedwater criterion of 3, it is not known if the higher **SDIs** will result in a greater rate of RO membrane fouling. Additional research is necessary to better define (1) the relationship between ZenoGem process operational characteristics (**MLVSS**, HRT and **SRT**) and **filtrate** SDI, (2) what compounds present in the ZenoGem and ZeeWeed filtrates are responsible for causing flow reductions in the **SDI** filter, and (3) what correlation filtrate **SDI** values have to actual fouling rates of RO membranes operated on either ZeeWeed or ZenoGem filtrate.

Within the level of accuracy of the analytical method used, total and fecal **coliform** levels in the filtrate were comparable for the two Phases of ZeeWeed operation. Again, positive counts were observed during Phase II. A membrane integrity test was performed following the conclusion of Phase I testing and chemical cleaning to **confirm** that there were no leaky or broken fibers or compromised areas where the fibers are potted into the module heads. To check integrity, the process tank was filled with potable water and compressed air was applied to the interior of the fibers. No air bubbles were observed in the tank that would signal a compromise of the membranes or potted areas. Consequently, a firm conclusion cannot be drawn regarding the presence of low numbers of coliforms in the ZeeWeed filtrate during both test phases. Possible causes include sample contamination and growth of coliforms within the filtrate piping and sampling system (filtrate was not disinfected during either phase of operation).

5.4.6 ZenoGem Process vs. Memcor MF System

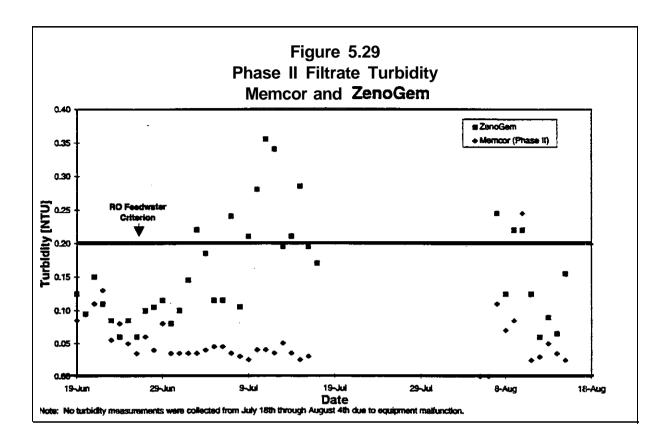
Filtrate characteristics of the ZenoGem process and Memcor system were compared based on results obtained during Phase II relative to RO feedwater requirements and for other selected water quality parameters. A similar comparison was described earlier in this report for ZeeWeed and Memcor systems based on Phase I testing. The water **quality** parameters for the effluent from Memcor MF system were nearly equal during Phase I and Phase II testing. Therefore, it is considered appropriate to directly compare results for the ZenoGem process to the Memcor MF system Phase II results. Table 5.19 presents the Memcor MF system and ZenoGem process water quality parameters and the results obtained during Phase II testing. These parameters are discussed below:

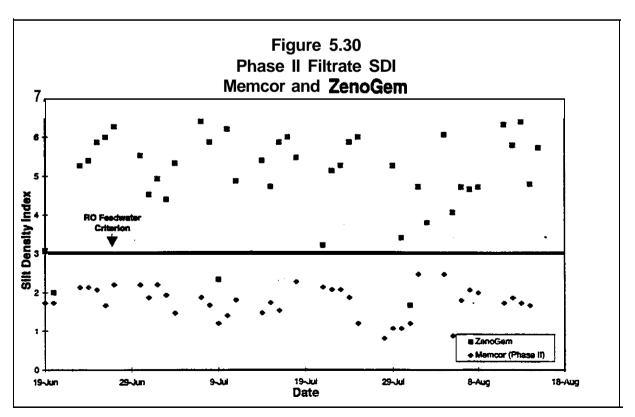
	No. of S	Samples	Ze	noGem Filt	rate	Memcor MF Filtrate			
Parameter	ZeeWeed	Memcor	Mean	Min	Max	Mean	Min	Max	
TDS (mg/L)	4	2	943	881	1.022	1,139	977	1,411	
Conductivity $(\mu s/cm)$	18	58	1,532	1,320	1,700	1,789	755	2,410	
TOC (mg/L)	8	9	7.7	6.6	9.3	6.9	5.3	8.1	
Color (color units)	8	9	17.8	10.0	25.0	9.6	0	20.0	
UV Absorbance @ 254 (1/cm)	16	17	0.14	0.11	0.18	0.11	0.09	0.14	
THM (mg/L)	2	2	21.9	21.9	21 . 9	317.4	310.3	324.4	
HAA (mg/L)	2	2	56.7	56.7	56.7	129.5	128.3	130.6	
oH ("nits)	59	58	7.34	6.90	7.77	7.09	6.86	8.16	
rss (mg/L)	8	9	0.57	0.20	1.00	0.30	ND'	1.00	
Turbidity (NTU)	8 2	78	0.16	0.06	0.36	0.10	ND	0.53	
SDI	43	4 0	4.99	1.67	6.40	2.11	0.40	7.60	
HPC (CFU/ml)	8	7	6,125	1.500	11.200	3516	264	12,000	
Total Coliform (CFU/100 ml)	7	7	7	3	11	5	ND	15	
Fecal Coliform (CFU/100 ml)	7	7	3	1	7	ND	ND	ND	

Table 5.19 —Water Quality Parameters

¹ND-Not Detected

Turbidity and SDI. Figures 5.29 and 5.30 present filtrate turbidity and SDI for the Memcor MF system and the ZenoGem process for Phase II. No turbidity values were collected between July 18 and August 4 because of a malfunction of the McAllen WWTP turbidimeter. Filtrate turbidity for ZenoGem was greater than for Memcor but still averaged below the RO feedwater criterion. As discussed in section 5.4.5.2 which compared ZeeWeed Phase I and ZenoGem filtrate SDI results, filtrate SDI values during Phase I were significantly greater for ZenoGem than for the ZeeWeed system. Mean SDI for ZenoGem was 5.0 versus 2.1 for Memcor during Phase II.





In general, discussions regarding comparison of filtrate quality for ZeeWeed MF operation on secondary effluent and ZenoGem operation are relevant here.

5.5 MF System Water Quality vs. Source Water Quality

The primary goal of IPR is to produce an effluent that is equivalent to or better than the quality of the raw water supply which it will supplement. Table 5.20 presents data for selected parameters of the source water that were also monitored in the three filtrate streams evaluated during this testing (Memcor filtrate, ZeeWeed filtrate, and ZenoGem filtrate). Table 5.21 presents particle count data that were obtained during the study. Counts in the size range greater than 10 to 15 microns were not measured. The following can be concluded from an examination of the data in tables 5.20 and 5.21:

MF treatment, in any form evaluated, is not capable of reducing the levels of dissolved parameters to match those present in McAllen's current raw water supply (source water). MF treatment has no effect on dissolved constituents and, hence some other treatment process will be needed to provide the necessary reduction in TDS, TOC, UVA-354, and compounds responsible for the formation of THMs and HAAs. As described in section 1.0, this process will, be reverse osmosis.

Although a measure of dissolved constituent, pH does not require additional treatment to be acceptable. (RO will reduce pH, however.)

All MF technologies evaluated can reduce turbidity and SDI to significantly lower levels than measured in the source water.

All **MF** technologies can produce filtrates with coliform characteristics similar to that of the source water. None appears capable of reducing **HPCs** to levels present in the source water, however. Again, additional and substantial reduction in these bacterial measurements can be anticipated with RO treatment of the MF filtrate.

Particle counts in the filtrate from all three MF systems are significantly lower than counts in the source water. Filtrate counts, however, were higher than what was anticipated. Other studies where Memcor and ZeeWeed technologies are used to treat surface water supplies to directly produce drinking water typically have particle counts of less than 5 per ml where care is taken to remove air bubbles from the stream prior to measurement. The higher counts observed in this study are attributed to (1) sample contamination caused by particle sloughing from growth in the filtrate piping and, sample tubing, and (2) entrained air in the samples not removed prior to introduction into the counter sensor.

		A	verage Result		
Parameter	Source Water'	Memcor Phase I and II Filtrate		ZenoGem Filtrate Phase II	Units
Inorganics					
UV-254	0.102	0.11	0.120	0.14	1/cm
TDS	746	1,139	1,216	943	mg/l
TOC	3.8	6.9	7.4	7.7	mg/l
SDS HAAs	65	129.5	127	56.7	µg/l
SDS THMS	226	317.4	289.4	21.9	µg/l
pН	8.1	7.09	8.07	7.34	Units
Turbidity	14.6	0.10	0.13	0.16	NTU
Silt Density Index	15.1	2.11	2.55	4.99	unitless
Total Coliform	20	5	8	7	CFU/1 00 ml
Fecal Coliform	5	ND	14	3	CFU/1 00 ml
HPC	1150	3,516	3,215	6,125	CFU/ml

Table 5.20.—RO Feedwater Quality Parameters ZeeWeed and Memcor Phases I and II

¹ Based on an average of two samples.

		Average Par	ticle Count	
		Memcor	ZeeWeed	ZenoGem
Particle Size	Source	Phases I and	Phase I	Phase II
(microns)	Water	II Filtrate	Filtrate	Filtrate
2.0 to 3.0	1128	49.2	65.0	34.5
3.0 to 5.0	5378	80.3	117.3	51.5
5.0 to 8.0	8037	63.4	127.0	30.1
8.0 to 10.0	3105	26.9	106.7	19.6
10.0 to 15.0	2526	Not	Not	Not
		Measured	Measured	Measured
> 15.0	686	Not	Not	Not
		Measured	Measured	Measured
Total'	17.648	219.8	416	135.7

Table 5.21.—Source Water and Filtrate Particle Counts Phase I and Phase II

¹ All particles from 2.0 to 8.0 microns in diameter.

6. COST ESTIMATES FOR IPR USING LIME AND MICROFILTRATION TREATMENT

This section presents cost estimates for advanced treatment systems to provide 6.8 mgd (25.7 ML/day) of reclaimed water that would serve as a supplemental source of raw water for the City of McAllen's drinking water supply. Cost estimates were developed for the following two alternative approaches to treating secondary effluent from the City's SWWTP to a quality suitable for discharge to a new raw water storage reservoir:

High-pH lime clarification, recarbonation, high-rate gravity filtration and RO and ultraviolet light (UV) disinfection.

Memcor MF, RO, and UV disinfection.

As presented above, both alternatives incorporate RO and UV disinfection. **High-pH** lime clarification was selected because it is the traditional method of clarification of secondary effluent prior to RO treatment and has been in use for this purpose since 1977, as described in section 1 of this report.

6.1 Cost Assumptions

Figures 6.1 and 6.2 present flow schematics for integrated IPR treatment systems using these process alternatives.

The cost estimates were prepared at an order-of-magnitude level, which is defined by the American Association of Cost Engineers as an approximate estimate made without detailed engineering data. The estimates were prepared to provide a relative cost comparison of the alternatives and are based on information available at the time; final costs for each of the alternatives will depend on actual labor and material costs, market conditions, project scope, implementation schedule, and other factors and will differ from the estimates presented. All costs are presented in present day dollars. Total annual unit costs are based on a product water flow of 6 mgd.

RO recovery is assumed to be 85 percent for each system, therefore, 15 percent of the RO inflow must be disposed. No costs for disposal have been included in these estimates. However, this cost can be substantial if mechanical evaporation is used. The cost for mechanical evaporation can nearly equal the cost for the liquid-side treatment facility. Costs for the chemical sludge generated by the **lime/RO** system have been reflected in the cost estimate.

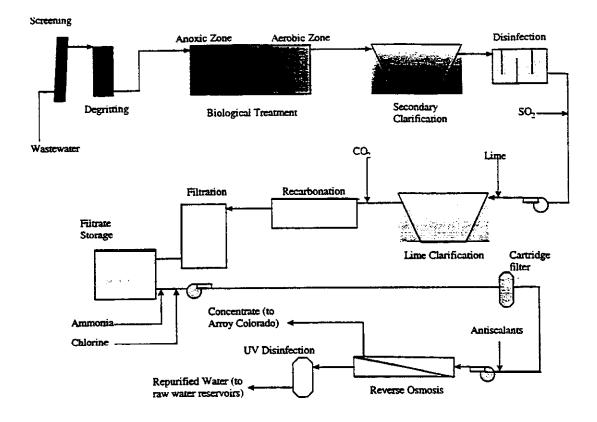


Figure 6.1. Process Flow Diagram for Lime-based IPR Treatment System

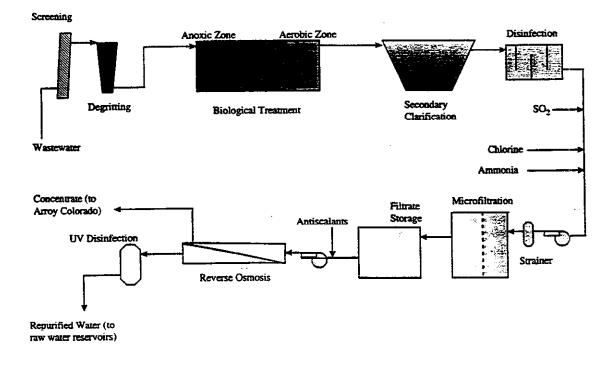


Figure 6-2. Process Row Diagram for W-based IPR Treatment System.

6.2 Cost Estimates

Estimates were prepared for the following cost categories:

Installed equipment, total construction, total capital, total unit capital, and amortized capital

Total operation and maintenance (O&M), total O&M unit

Total annual and total annual unit

Table 6.1 presents the cost estimates for the two alternatives. The table also lists the fundamental **assumptions** necessary to develop design and O&M criteria for each unit operation and process. **CH2M** HILL and third party reference materials that were used, where appropriate, in developing the estimates are also shown in the Table 6.1.

The estimates indicate that the MF-based alternative has a slightly greater estimated capital cost, but a significantly lower estimated **O&M** cost relative to the lime-based alternative. As a result, the estimated total annual cost for the MF-based alternative is approximately 10 percent lower than for the lime-based alternative. Within the accuracy of the estimating method, this difference is not considered significant. However, it does indicate that **MF-based** IPR treatment is cost-competitive with **lime**-based treatment, if not potentially cheaper. The MF process is much simpler to operate and requires significantly less chemical handling and chemical sludge disposal.

6.3 ZeeWeed/ZenoGem Costs

Costs are not presented for a ZeeWeed MF system because they were not included in the Scope of **the** Original Proposal. In order to compare Memcor and ZeeWeed MF systems on a cost basis, the following items would need to be addressed:

Major process equipment for each system

Building area requirements

•

MF feedwater screening

MF feedwater disinfection (chlorine and ammonia for Memcor, possibly nothing for ZeeWeed)

Although costs were not developed for the ZeeWeed system, capital costs for the ZeeWeed unit are estimated to be higher when the system is operated on raw wastewater (Phase II) as opposed to secondary effluent (Phase I). This is due to the ZeeWeed unit operating at a higher flux on secondary effluent during the study. However, this cost difference is mitigated by the following factors:

able 6-1. Irder-of Magnitude Cost Estimates fo	I Ime. and ME.	head Trantment	Alternativas	
rder-of Magnitude Cost Estimates id	MF-based	Lime-based	Fundamental	
	Atternative	Alternative	Assumptions	Cost Reference
APITAL COST OPINION			• • • • • • • • • • • • • • • • • • • •	1
Init Process Component Installed Cost				
WITP BNB Batrofit	\$2,000,000	\$2,000,000	10 mgd, baffle addition, anoxic mixers, 6:1 recycle pumping	SDA BNR Manual pp. 51-59
ime influent Pumping		\$170,000	3-3.625 mgd pumps @ 15 psig	West Basin Sch. of Values
ime Clarification		\$1,000,000	2-3.625 mgd clarifiers, 1 gpm/sl SOR, 2 thickeners	IDI Densadeg Quole
lydrated Lime Storage & Feed		\$220,000	7.25 mgd, 300 mg/1 lime dose	EPA Est. WTP Costs p. 53
olymer Storage & Feed		\$80,000	7.25 mgd, 5 mg/ polymer dose	EPA Est. WTP Costs D. 53
Inthickened Lime Sludge Pumping		\$105,000	2.2 lb solids/b lime, 2% solids, 166 gpm	EPA Est. WTP Costs p. 351
Ime Słudge Gravity Thickening		\$340,000	40,000 lb solids/d, 20 lb/sl/d SLR, 2 thickeners	EPA Est. WTP Costs p. 370
hickened Lime Sludge Pumping		\$20,000	8% solids, 42 gpm	EPA Est. WTP Costs p. 363
hickener Decant Pumping		\$30,000	168 gpm @ 15 palg	EPA Est. WTP Costs p. 239
Ime Sludge Drying Beds		\$525,000	10 drying cycles/yr, 2 ft. bed thickness, 2 acres	EPA Est. WTP Costs p. 414
lecarbonation Basins			7.25 mgd, 10 minute detention, 2 basins	Jonathan Rogers WTP Bid, West Basin Sch. of Values
Carbon Dioxide Storage & Feed			7.25 mgd, 100 mg/l carbon dioxida dose	Jonathan Rogers WTP Bid, West Basin Sch. of Values
Stanular Media Filtration		\$1,920,000	7.25 mgd, 4 gpm/st SLF, 4-420 st lillers	Jonalhan Rogers WTP Bid, West Basin Sch. of Values
iller Backwash Recovery System		\$200,000	4-filter backwash volumes, 20 gpm/sf for 10 minutes, decant recycle, undertiow to time thickeners	1DI Densadeg Quole
Sedium Hypechlorite Storage & Feed	\$220,000	\$220,000	R mad 3 mai dose	Central Wyoming Pretim Engr. Estimate
Qua Ammonia Storage & Feed	\$35,000	\$35,000	R mad 1 mai dose	EPA Est WTP Costs p. 95
AF Influent Pumping	\$554.000		3.4 mgd pumps @ 45 pslg	West Besin Sch. of Values
AF Pre-screening	\$120.000		3-4 mod sell-backwashing units	S.P. Klopey Quote
MF System	\$4,540,000		2 trains of 4-80M10C units, 0.45 gpm/m2 flux, 90% recovery-	Memcor Quoles
AF Building	\$710.000		1 st per kost product capacity	\$100/s(bido.
AF Backwash Recevery System	\$260,000		0.76 mgd clarification system, underflow to existing solids handling	IDI Densaden Quote
Filtrate Storage	\$1 200,000		7.1 mod. 4 hour detention	Jonathan Rogers WTP Bid, West Basin Sch. of Values
10 System & Building ¹	\$4,860,000	\$4,850,000	3-2 mgd traine, 10 4 gld flux, 85% recevery, PA membranes	West Besin Sch. of Values
O System & Busiding			feed pressure 225 pela	
JV Disinlection System	\$1,400,000		2-3 mgd channala, 80% UV transmittance, 120.000 UW-s/cm2 UV dose. UV lamp intensity = 5,145 uW/cm2, 24 s detention, 1,668 gat,	SAWPA RIX Preikm. Engr. Estimate
nstalted Costs Subtotal	\$15,889,000	\$14,795,000	2 geltemp, 634 lamps, 0.25kVAtomp	
Jait Process Noncomponent Costs				
Yard Piping Allowance (10%)	\$1,569,900	\$1,479,500		
Site Electrical Allowance (8%)	\$1,271,120			
Site I&C Allowance (5%)	\$794,450			
Site Civit Atlowance (5%)	\$794,450			
Unit Process Subtotal	\$20,337,920			
	\$4,067,584			
Conlingency (20%) Contractor Overhead & Mark-Up (10%)	\$2,033,792			
Contractor Civerneed & Merk-Up (10%) Total Construction Cost	\$28,439,295			
Engineering & Administration (15%)	\$3,965,894			····
Total Capital Cost	\$30,405,190			
fotal Capital Unit Cost	\$5.01			

Order-of Magnitude Cost Estimates fo	MF-based	Lime-based	Fundamental	
	Alternative	Atternative	Assumptions	Cost Reference
ANNUAL OLM COST OPINION				
Major Chamical Costs				
lme		\$331,000	\$100/ton	
Polymer			\$1,500/ton	
Carbon Dioxide		\$110,000		
Sodium Hypochlorite	\$44,000	\$39,000	\$1,200/ton	
Ammonia	\$2,400	\$2,100	\$200Aon	
Scale Inhibitor	\$97,000		\$3,000/ton, 3 mg/l dose	
Malor Power Costs			\$0.06/kwh	
UNR Anoxic Zone Mixing	\$49,000	\$49,000	6 hr detention, 50 HP/MG Basin	
BNR Recycle Pumping	\$31,000	\$31,000	3:1 Ratio = 30 mgd @ 10 ft. TDH	
Lime Influent Pumping		\$26,000		
MF Influent Pumping	\$85,000			
RO Influent Pumping	\$376,000	\$508,000	Additional 80 psig feed pressure for Lime/RO compared to MF/RO	
UV Disinfection	\$12,000	\$12,000		
Major Membrane Maintenance Coste				
Membrane Cleaning Costs	\$22,000		AN OTINDATIOL WEIMON, AN ORIKOBI IOL FINBLING	
Cartridge Filter Replacement			12 per year, 5 gpm/cartridge, \$1.35/cartridge	
MF Membrane Replacement	\$94,000		Replacement frequency 5 yrs, \$650/module	
RO Membrane Replacement	\$196,000		Replacement frequency: 5 yrs MF/RO, 4 yrs Lime/RO; \$850/element, 500 sf/element	
UV Lamp Replacement	\$7,000		Replacement frequency 5 yrs, \$41/lamp	
Lime Studge Disposal			\$31.6 per dry ton	
Additional Labor Requirement	\$32,000		3 FTE for Lime/RO, 1.5 FTE for MF/RO at \$21,000/FTE	
Annual General Maintenance Costs	\$304,052		1% of total capital cost	
Total Annual O&M Cost	\$1,351,452	\$2,101,217		
Total Annual O&M Unit Cost	\$0.62	\$0.96		
Total Annual Cost	\$4,221,702	\$4,773,843		
Fotal Annual Unit Cost	\$1.93	\$2.18	Based on 6 MGD product water flow	

ZenoGem could be used in place of both primary and secondary treatment systems as well as for MF treatment of the secondary effluent.

ZeeWeed modules could be installed directly into existing concrete structures for the ZenoGem process, deferring the cost of new tanks which would be required for the ZeeWeed MF unit if treating only secondary effluent.

The lower rate of membrane fouling experienced during Phase II, suggests that the ZeeWeed modules may be capable of operating at a higher flux to provide comparable cycle times between chemical cleanings.

7. **BIBLIOGRAPHY**

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Appendix A. Photographs of Pilot Plant Facilities and Associated Equipment



Exhibit A-1. Extraction point for disinfected, dechlorinated effluent.



Exhibit A-2. Extraction point for screened, de-gritted wastewater splitter box.

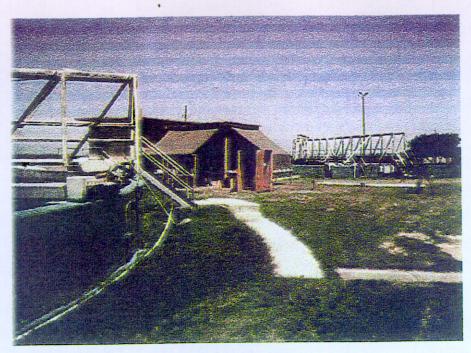


Exhibit A-3. Location of Pilot Plant (located between secondary clarifiers).

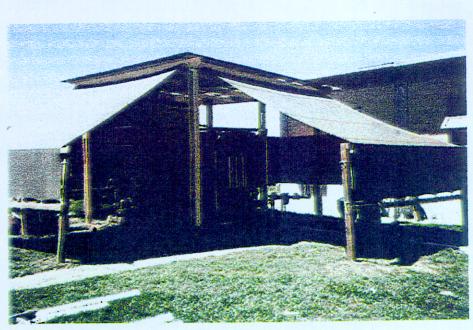


Exhibit A- 4. Pilot plant facility (located to the east of sludge pump house).

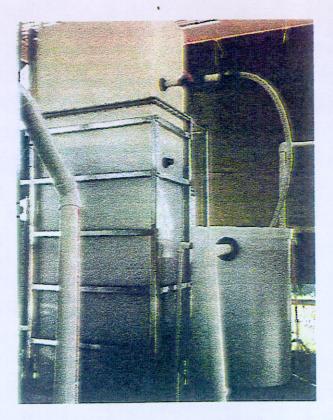


Exhibit A-5. Feed and process tanks for Zeeweed MSTD 2W-4 MF unit.

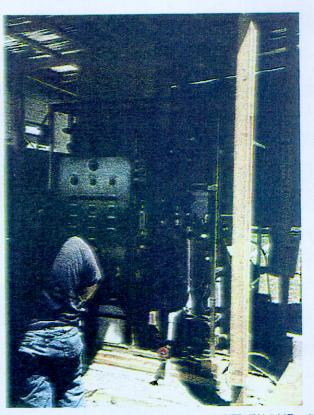


Exhibit A-6. Panel-side view of Zeeweed MSTD 2W-4 MF unit (field technician in foreground).

APP-3

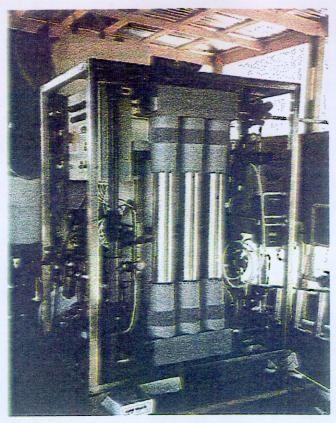


Exhibit A-7. Memcor 3M10C unit showing membrane modules.



Exhibit A-8. Extended basins at McAllen WWTP.

Appendix B. Phase I and Phase II Operating and Water Quality Data

					Rec	orded Data						Calcul	ated Data
	Cumulative		Feed	Recirculation	Filtrate			Filtrate	Totalized*		Water		
	Operating Time	Hour Run	Pressure	Pressure	Pressure		Feed Flow	Flow	Fillrate Flow	Flow	Temperature	Flux	
Date & Time	(hrs)	Meler	(psi)	(psi)	psi	 TMP [psl] 	(gpm)	(gpm)	[gal]	Totalizer	(°F)	(gpd/ft ²)	Recovery 9
Thu 4/10/97 8:45		4,269.1	22.2	20	17.1	5.1	19.5	19.5			70	25.97	90.70
Mon 4/14/97 9:00	91.50	4,360.6	25.9	23.7	12.2	13.7	19.2	19.2	105,408	11,302	56	25.57	90.57
Mon 4/14/97 13:30	95.80	4,364.9	25.8	23.5	11.8	14.0	18.8	18.8	110,258	11,762	64	25.03	90.38
Tue 4/15/97 10:00	111.40	4,380.5	26.0	22.8	10.5	15.5	19.0	19.0	128,042	13,983	60	25.30	90.48
Tue 4/15/97 13:30	118.90	4,388.0	25.9	22.6	10.9	15.0	19.4	19.4	136,772	14,310	73	25.83	90.65
Wed 4/16/97 8:30	137.30	4,408.4	27.4	24.1	11.4	16.0	19.8	19.8	158,632	16,352	72	26.37	90.83
Ned 4/16/97 13:30	143.00	4,412.1	26.0	22.7	11.0	15.0	19.6	19.6	165,335	16,875	73	26.10	90.74
Thu 4/17/97 8:15	160.30	4,429.4	27.3	22.3	11.5	15.8	20.0	20.0	186,095	18,850	74	26.63	90.91
Thu 4/17/97 13:30	165.90	4,435.0	27.6	22.3	11.6	16.0	20.0	20.0	192,815	19,426	74	26.63	90.91
Fri 4/18/97 8:00	183.30	4,452.4	27.8	22.5	16.0	16.8	20.3	20.3	214,008	21,371	62	27.03	91.03
Frl 4/18/97 13:45	185.20	4,454.3	26.1	21.1	10.7	15.4	19.8	19.0	216,265	21,579	74	26.37	90.83
Sal 4/19/97 8:30	203.90	4,473.0	27.4	22.1	10.8	16.6	20.0	20.0	238,705	23,564	73	26.63	90.91
Sal 4/19/97 12:35	207.30	4,476.4	25.9	20.7	10.2	15.7	19.3	19.3	242,842	23,970	76	25.70	90.61
Sun 4/20/97 8:00	226.20	4,495.3	27.8	22.4	11.1	16.7	20.3	20.3	265,663	26,045	76	27.03	91.03
Sun 4/20/97 12:30	230.90	4,500.0	26.3	21.5	10.4	15.9	19.9	19.9	271,274	26,513	78	26.50	90.87
Mon 4/21/97 8:00	249.90	4,519.0	27.3	22.7	10.8	16.5	20.1	20.1	294,188	28,636	75	26.77	90.95
Mon 4/21/97 14:00	255.10	4,524.2	25.4	20.6	10.1	15.3	19.5	19.5	300,272	29,214	82	25.97	90.70
Tue 4/22/97 9:30	274.20	4,543.3	26.3	21.6	10.1	16.2	19.2	19.2	322,276	31,288	78	25.57	90.57
Tue 4/22/97 13:30	277.90	4,547.0	25.4	20.5	8.6	16.8	18.3	18.3	326,338	31,682	85	24.37	90.15
Wed 4/23/97 8:45	296.90	4,566.0	27.7	23.2	10.7	17.0	18.8	18.8	347,770	33,584	74	25.03	90.38
Ned 4/23/97 13:45	301.30	4,570.4	21.2	21.7	9.0	17.2	18.0	18.0	352,522	34,053	80	23.97	90.00
Thu 4/24/97 9:00	319.70	4,588.8	27.7	23.3	10.5	17.2	16.5	16.5	370,738	35,860	74	21.97	89.19
Thu 4/24/97 15:20	325.20	4,594.3	26.0	21.6	10.0	16.0	17.3	17.3	376,447	36,255	78	23.04	89.64
Fri 4/25/97 8:00	325.20								376,447				
Fri 4/25/97 14:30	325.20				4.0.0	44.0	40.7	40.7	376,447	07.004	74	00.04	89.30
Sat 4/26/97 8:00	346.20	4,615.3	27.8	23.5	15. 9	11.9	16.7	16.7	5,000,978	37,991	74	22.24	88.89
Sat 4/26/97 12:30	350.90	4,620.0	25.3	21.1	14.0	11.3	16.0	16.0	5,005,490	38,396	77	21.31 22.77	89.53
Sun 4/27/97 8:30	370.00	4,639.1	28.0	23.6	15.3	13.3	17.1	17.1	5,025,086	40,226	71		90.00
Sun 4/27/97 12:30	373.60	4,642.7	25.1	21.2	13.6	12.5	18.0	18.0	5,028,974	40,572	72 68	23.97 22.11	90.00 89.25
Mon 4/28/97 8:00	392.90	4,662.0	28.0	23.3	15.4	12.6	. 18.6	16.6	5,048,197	42,408	80		89.01
Mon 4/28/97 13:00	397.90	4,667.0	25.4	21.1	13.3	12.1	16.2	16.2	5,053,057	42,858		21.57	89.01
Tue 4/29/97 9:00	416.90	4,686.0	26.2	22.0	11.0	14.6	18.3	16.3	5,071,639	44,652	73 76	21.71 21.71	89.07
Wed 4/30/97 8:30		4,704.3	25.7	22.0	14.7	11.0	16.3	16.3	5,089,537	46,362			89.07
Wed 4/30/97 14:00		4,712.2	26.9	22.9	16.1	10.8	16.6	16.6	5,097,405	46,842	80	22.11	
Thu 5/1/97 8:00		4,730.0	27.7	23.8	17.0	10.7	16.6	16.6	5,115,134	48,433	77	22.11	89.25
Thu 5/1/97 14:00		4,735.3	25.1	21.5	14.9	10.2	16.1	16.1	5,120,254	48,966	81	21.44	88.95
Frl 5/2/97 8:30		4,754.0	25.5	21.8	15,1	10.4	16.0	16.0	5,138,206	50,665	79	21.31	80.89
Frl 5/2/97 13:30		4,758.3	26.1	22.2	15.5	10.6	16.5	16.5	5,142,463	51,096	82	21.97	89.19
Sat 5/3/97 8:30		4,776.8	27.8	23.7	16.4	11.4	16.8	16.8	5,161,111	52,601	70	22.37	89.36
Sat 5/3/97 11:30		4,781.2	25.9	22.0	15.2	10.7	16.1	16.1	5,165,361	53,029	76	21.44	88.95
Sun 5/4/97 8:00		4,800.0	27.9	24.0	16.3	11.6	16.5	16.5	5,183,973	54,862	74	21.97	89.19
Sun 5/4/97 12:30	534.90	4,804.0	24.8	21.0	14.2	10.6	16.0	16.0	5,187,813	55,237	79	21.31	88.89

ie.

	Cumulative		Feed	Recirculation	Filtrate			Filtrate	Totelized*	······	Waler		
	Operating Time	Hour Run	Pressure	Pressure	Pressure		Feed Flow	Flow	Filtrate Flow	Flow	Temperature	Flux	
Date & Time	(hrs)	Meter	[psi]	(psi)	psl	TMP (psl)	(gpm)	(gpm)	(gal)	Totalizer	(°F)	(gpd/ft²)	Recovery %
Mon 5/5/97 7:30	553.20	4,822.3	28.2	24.6	16.3	11.9	16.5	16.5	5,205,930	56,958	73	21.97	89.19
Mon 5/5/97 13:30	558.90	4,828.0	27.5	23.6	15.8	11.7	16.9	16.9	5,211,710	57,473	79	22.50	69.42
Tue 5/6/97 7:30	576.90	4,846.0	26.1	24.5	16.3	11.8	16.5	16.5	5,229,530	59,084	76	21.97	89.19
Tue 5/6/97 13:30	586.90	4,856.0	25.2	21.3	13.8	11.4	16.0	16.0	5,239,130	59,570	80	21.31	88.69
Wed 5/7/97 8:00	600.10	4,869.2	26.5	22.6	14.9	11.6	16.6	16.6	5,252,277	61,220	78	22.11	89.25
Wed 5/7/97 14:00	605.90	4,875.0	26.9	23.0	15.2	11.7	16.7	16.7	5,258,089	61,708	86	22.24	89.30
Thu 5/8/97 7:30	622.90	4,892.0	27.5	23.7	15.4	12.1	16.7	16.7	5,275,123	63,277	76	22.24	89.30
Thu 5/8/97 14:00	628.90	4,898.0	28.1	24.2	18.1	12.0	16.8	16.8	5,281,171	63,834	81	22.37	89.36
Fri 5/9/97 7:30	646.00	4,915.1	26.1	22.4	14.6	11.5	15.9	15.9	5,297,484	65,371	79	21.17	88.83
Fri 5/9/97 13:00	651.20	4,920.3	27.6	23.7	15.7	11 <i>.</i> 9	16.6	16.6	5,302,663	65,839	82	22.11	89.25
Sat 5/10/97 7:30	670.50	4,939.6	28.1	23.9	15.1	13.0	16.6	16.3	5,321,539	67,552	79	21.71	89.07
Sat 5/10/97 13:10	675.50	4,944.6	25.6	22.0	13.2	12.4	15.2	15.2	5,326,099	68,013	74	20.24	88.37
Sun 5/11/97 7:30	692.20	4,961.3	28.0	24.0	14.0	13.3	16.1	16.1	5,342,231	69,508	71	21.44	86.95
Sun 5/11/97 13:30	697.60	4,966.7	25.7	21.9	13.3	12.4	15.2	15.2	5,347,158	69,955	78	20.24	88.37
Mon 5/12/97 8:00	716.30	4,985.4	26.0	23.9	14.8	13.7	16.1	16.1	5,385,220	71,628	75	21.44	88.95
Man 5/12/97 13:30	721.40	4,990.5	25.4	21.5	12.9	12.5	16.0	16.0	5,370,118	72,070	80	21.31	86.89
Tue 5/13/97 7:30	721.40								5,370,116				
Tue 5/13/97 13:30	721.40								5,370,118				
Wed 5/14/97 8:00	747.60	5,018.7	27.7	24.4	19.4	8.3	17.7	17.7	10,697,851	74,382	78	23.57	89.85
Wed 5/14/97 13:04	751.40	5,020.5	25.7	22.4	18.0	7.7	16.4	16.4	10,701,590	74,732		21.84	89.13
Thu 5/15/97 8:00	769.50	5,038.6	26.0	23.2	18.2	7.8	16.5	16.5	10,719,509	76,415	79	21.97	89.19
Thu 5/15/97 13:00	774.30	5,043.4	25.6	22.1	17.7	7.9	16.5	16.5	10,724,261	76,820	82	21.97	89.19
Frl 5/16/97 8:00	792.70	5,061.8	27.6	24.1	19.7	8.1	16.5	16.5	10,742,477	78,559	79	21.97	89.19
Fri 5/16/97 13:00	797.60	5,066.7	25.2	21.7	17.0	8.2	16.4	16.4	10,747,299	79,012	80	21.84	89.13
Sat 5/17/97 8:00	815.70	5,084.8	27.0	23.7	19.3	8.3	16.1	16.1	10,764,784	80,648	82	21.44	88.95
Sal 5/17/97 14:00	820,90	5,090.0	25.4	21.7	17.5	7.9	16.5	16.5	10,769,932	81,124		21.97	89.19
Sun 5/18/97 8:00	838.50	5,107.6	27.9	24.3	19.8	8.1	16.3 [°]	16.3	10,787,144	82,790	79	21.71	89.07
Sun 5/18/97 13:00	843.40	5,112.5	25.6	21.7	17.8	8.0	16.3	16.3	10,791,937	83,209	82	21.71	89.07
Mon 5/19/97 8:00	861.50	5,130.6	28.6	24.6	20.3	8.3	16.5	16.5	10,809,856	84,849	80	21.97	89.19
Mon 5/19/97 13:00	866.40	5,135.5	25.9	22.1	17.4	8.5	16.5	16.5	10,814,707	85,300	82	21.97	89.19
Tue 5/20/97 8:00	884.70	5,153.8	28.6	24.9	19.8	8.8	16.5	16.5	10,832,824	87,019	78	21.97	89.19
Tue 5/20/97 13:00	889.60	5,158.7	27.4	23.5	18.7	8.7	16.5	16.5	10,837,675	87,474	80	21.97	89.19
Wed 5/21/97 8:00	907.60	5,176.7	28.5	24.4	19.5	9.0	16.5	16.5	10,855,495	89,080	79	21.97	89.19
Wed 5/21/97 13:00	912.70	5,181.8	28.7	24.4	19.8	8.9	16.5	16.5	10,860,544	89,56 0	82	21.97	89.19
Thu 5/22/97 8:00	930.70	5,199.8	28.2	24.3	19.3	8.9	16.5	16.5	10,878,364	91,172	79	21.97	89.19
Thu 5/22/97 13:00	935.80	5,204.9	25.6	21.7	16.7	9.0	16.5	16.5	10,883,413	91,650	82	21.97	89.19
Frl 5/23/97 8:00	954.00	5,223.1	25.8	21.9 -	16.5	9.3	16.5	18.5	10,901,431	93,333	78	21.97	89.19
Fri 5/23/97 13:00	958.90	5,220.0	25.8	22.0	16.7	9.1	16.5	16.5	10,906,282	93,803	80	21.97	89.19
Sat 5/24/97 8:00	977.50	5,246.6	26.1	22.2	16.7	9.4	16.4	16.4	10,924,584	85,507	82	21.84	89.13
Sat 5/24/97 14:00	982.80	5,251.9	25.4	21.8	16.3	9.1	16.5	18.5	10,929,831	98,013	84	21.97	89.19
Sun 5/25/97 8:00	1000.50	5,269.6	28.1	24.2	18.3	9.8	16.5	t6.5	10,947,354	97,673	80	21.97	89.19
Sun 5/25/97 11:00	1003.40	5,272.5	27.5	23.4	18.6	8.9	16.5	16.5	10,950,225	97,939	85	21.97	89.19
Mon 5/26/97 8:00	1023.50	5,292.6	28.6	24.7	18.8	9.8	16.5	16.5	10,970,124	99,772	82	21.97	89.19

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	Operating Time	Hour Run	Pressure	Pressure	Pressure		Feed Flow	Flow	Filtrate Flow	Flow	Temperature	Flux	
Date & Time	[ard]	Meter	(psi)	{psi]	(psl)	TMP [psi]	(gpm)	[gpm]	(gal)	Totalizer	[°F]	[gpd/ft ²]	Recovery %
Mon 5/28/97 11:00	1026.70	5,295.8	25.7	21.7	16.9	8.8	16.5	16.5	10,973,292	100,068	85	21.97	89.19
Tue 5/27/97 8:00	1046.70	5,315.8	28.6	24.8	19.3	9.3	16.5	16.5	10,993,092	101,839	82	21.97	89.19
Tue 5/27/97 13:00	1051.60	5,320.7	28.7	24.8	19.7	9.0	16.5	16.5	10,997,943	102,299	86	21.97	89.19
Wed 5/28/97 8:00	1069.90	5,339.0	27.7	23.7	18.2	9.5	16.5	16.5	11,018,060	103,874	80	21.97	89.19
Wed 5/28/97 13:00	1074.70	5,343.8	25.5	21.7	16.1	9.4	16.5	16.5	11,020,812	104,325	83	21.97	89.19
Thu 5/29/97 8:00	1092.90	5,362.0	28.4	24.3	17.4	11.0	18.0	18.0	11,040,468	106,046	80	23.97	90.00
Thu 5/29/97 13:00	1097.60	5,366.7	25.4	21.6	14.8	10.6	18.0	18.0	11,045,544	106,537	84	23.97	90.00
Fri 5/30/97 8:00	1114.20	5,383.3	27.7	23.7	16.3	11.4	18.0	18.0	11,083,472	108,242	81	23.97	90.00
Fri 5/30/97 13:00	1119.10	5,388.2	28.0	23.9	17.0	11.0	18.0	18.0	11,068,764	108,748	84	23.97	90.00
Sat 5/31/97 8:00	1137.30	5,406.4	27.8	23.8	15.7	12.1	18.0	18.0	11,088,420	110,607	82	23.97	90.00
Sat 5/31/97 12:00	1140.70	5,409.8	25.8	21.9	15.1	10.7	18.0	18.0	11,092,092	110,939	86	23.97	90.00
Sun 6/1/97 8:00	1159.80	5,428.9	28.5	24.5	16.7	11.8	18.0	18.0	11,112,720	112,795	82	23.97	90.00
Sun 6/1/97 11:00	1163.20	5,432.3	25.6	21.7	14.7	10.9	18.0	18.0	11,116,392	113,125	87	23.97	90.00
Mon 6/2/97 8:00	1182.80	5,451.9	28.3	24.3	15.6	12.7	18.0	18.0	11,137,560	115,122	79	23.97	90.00
Mon 6/2/97 13:00	1187.90	5,457.0	28.3	24.2	16.0	12.3	18.0	18.0	11,143,060	115,639	84	23.97	90.00
Tue 6/3/97 8:00	1205.90	5,475.0	27.9	24.0	14.9	13.0	18.0	18.0	11,162,508	117,406	78	23.97	90.00
Tue 6/3/97 13:00	1210.00	5,479.1	27.4	23.4	14.5	12.9	18.0	18.0	11,166,936	117,812	64	23.97	90.00
Wed 6/4/97 8:00	1228.20	5,497.3	28.2	24.3	14.3	13.9	18.0	18.0	11,186,592	119,651	79	23.97	90.00
Wed 6/4/97 13:00	1233.20	5,502.3	25.9	22.0	12.1	13.8	18.0	18.0	11,191,992	120,156	83	23.97	90.00
Thu 6/5/97 8:00	1251.20	5,520.3	27.9	24.0	13.0	14.9	18.0	18.0	11,211,432	121,942	80	23.97	90.00
Thu 6/5/97 13:00	1256.20	5,525.3	25.8	22.1	11.1	14.7	18.0	18.0	11,216,832	122,456	84	23.97	90.00
Frl 6/6/97 8:00	1273.30	5,542.4	28,1	24.5	12.5	15. 6	18.0	18.0	11,235,300	124,182	81	23.97	90.00
Frl 6/6/97 13:00	1278.30	5,547.4	28.4	24.4	13.0	15.4	18.0	18.0	11,240,700	124,690	83	23.97	90.00
Sat 6/7/97 8:00	1296.60	5,565.7	27.9	24.2	12.0	15.9	18.0	18.0	11,260,464	126,470	60	23.97	90.00
Sat 6/7/97 13:00	1301.80	5,570.9	27.6	23.9	12.0	15.6	18.0	18.0	11,266,080	126,959		23.97	90.00
Sun 6/8/97 8:00	1320.40	5,589.5	28.2	24.5	11.6	16.6	18.0	18.0	11,286,168	128,716	62	23.97	90.00
Sun 6/8/97 13:00	1325.40	5,594.5	27.6	23.9	11.6	16.0	18.0	18.0	11,291,568	129,139		23.97	90.00
Mon 6/9/97 8:00	1325.40	•••••							11,291,568	•			
Mon 6/9/97 13:00	1325.40								11,291,568				
Tue 6/10/97 8:00	1366.00	5,635.1	28.4	24.7	9.3	19.1	18.0	18.0	17,377,476	133,091	82	23.97	90.00
Tue 6/10/97 12:00	1369.80	5,638.9	28.4	24.6	8.7	19.7	18.0	18.0	17,381,580	133,470		23.97	90.00
Wed 6/11/97 8:00	1389.20	5,658.3	27.7	24.0	16.5	11.2	18.0	18.0	17,402,532	135,321	86	23.97	90.00
Wed 6/11/97 13:00	1394.40	5,663.5	28.3	24.6	17.1	11.2	18.0	18.0	17,408,148	135,818	94	23.97	90.00
Thu 6/12/97 8:00	1412.50	5,601.6	27.9	24.4	16.7	11.2	18.0	18.0	17,427,696	137,700	82	23. 9 7	90.00
Thu 6/12/97 9:00	1413.10	5,682.2	28.2	24.5	16.8	11.4	18.0	18.0	17,428,344	137,752		23.97	90.00
Fri 6/13/97 8:00	1429.80	5,698.9	25.7	22.2	15.0	10.7	18.0	18.0	17,446,380	139,451	82	23.97	90.00
Fil 8/13/97 14:00	1434.10	5,703.2	27.8	24.0	17.2	11.6	18.0	18.0	17,451,024	139,982	95	23.97	90.00
Sat 6/14/97 7:00	1451.40	5,720.5	26.4	23.0	15.9	10.5	18.0	18.0	17,469,708	141,602	85	23.97	90.00
Sat 6/14/97 15:00	1458.10	5,727.2	26.3	22.7	15.6	10.7	18.0	18.0	17,476,944	142,338	96	23.97	90.00
Sun 6/15/97 7:00	1474.90	5,744.0	26.1	22.6	15.1	11.0	18.0	18.0	17,495,088	143,947	80	23.97	90.00
Sun 6/15/97 13:00	1480.10	5,749.2	26.1	22.6	14.3	11.8	18.0	18.0	17,500,704	144,474	91	23.97	90.00
Mon 6/16/97 7:00	1497.90	5,767.0	27.1	23.5	16.7	10.4	18.0	18.0	17,519,928	146,244	83	23.97	90.00
Mon 6/16/97 15:00	1504.90	5,774.0	25.9	22.6	16.4	9.5	18.0	18.0	17,527,488	146,945	91	23.97	90.00
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			Feed	Recirculation	Filtrate			Filtrate	Totalized*		Water		
	Cumulative		• = =	Pressure	Pressure		Feed Flow	Flow	Filtrate Flow	Flow	Temperature	Flux	
	Operating Time	Hour Run		[psl]	[psi]	TMP (psl)	(gpm)	(gpm)	[gal]	Tolalizer	[°F]	(gpd/ll ²)	Recovery %
Date & Time	{his]	Melar	[psi] 27.7	24.7	17.6	10.1	18.0	18.0	17,544,552	148,535	85	23.97	90.00
Tue 6/17/97 7:00	1520.70	5,789.6	27.7	24.7	18.9	9.8	18.0	18.0	17,552,868	149,293	94	23.97	90.00
Tue 6/17/97 15:00	1528.40	5,797.5	26.7	20.0	15.8	10.2	18.0	18.0	17,570,148	150,868	76	23.97	90.00
Wed 6/18/97 7:00	1544.40	5,813.5 5,800.5	28.1	24.5	17.6	10.5	18.0	18.0	17,577,708	151,836	92	23.97	90.00
Wed 6/18/97 15:00	1551.40	5,820.5 5,838.5	26.2	23.0	16.0	10.2	17.9	17.9	17,594,892	153,326	85	23.84	89.95
Thu 6/19/97 7:00	1567.40 1574.90	5,830.5 5,844.0	27.9	24.4	17.5	10.4	18.0	18.0	17,602,992	154,121	94	23.97	90.00
Thu 6/19/97 15:00	1590.90	5,860.0	27.9	24.6	17.1	10.8	18.0	18.0	17,620,272	155,774	82	23.97	90.00
Fri 6/20/97 7:00 Fri 6/20/97 15:00	1598.40	5,867.5	25.8	22.5	16.0	9.8	18.0	18.0	17,628,372	156,508	93	23.97	90.00
Sat 6/21/97 7:00	1613.60	5,882.7	27.8	24.6	17.4	10.4	18.0	18.0	17,644,788	150,076	81	23. 9 7	90.00
Sat 6/21/97 15:00		5,890.5	27.7	24.3	17.6	10.2	18.0	18.0	17,653,212	158,851	94	23.97	90.00
Sun 6/22/97 7:00	1634.40	5,903.5	28.1	24.7	17.3	10.8	18.0	18.0	17,667,252	160,542	84	23.97	90.00
Sun 8/22/97 15:00	1645.10	5,914.2	27.6	24.3	16.9	10.7	18.0	18.0	17,678,808	161,180	92	23.97	90.00
Mon 6/23/97 7:00	1660.40	5,929.5	28.0	24.7	16.9	11.1	18.0	18.0	17,695,332	162,8 30	79	23.97	90.00
Mon 6/23/97 13:00	1665.90	5,935.0	25.8	22.6	15.3	10.5	18.0	18.0	17,701,272	163,370	84	23.97	90.00
Tue 6/24/97 7:00		5,953.1	27.9	24.4	16.7	11.2	18.0	18.0	17,720,820	165,115	81	23.97	90.00
Tue 6/24/97 15:00		5,956.0	28.2	25.2	19.6	8.6	19.9	20.0	17,725,020	165,372	86	26.63	90.91
Wed 6/25/97 7:00		5,973.2	27.8	24.4	18.7	9.1	18.0	18.0	17,742,948	167,140	81	23.97	90.00
Wed 6/25/97 15:00		5,980.5	25.6	22.3	17.1	8.5	18.0	18.0	17,750,832	167,865	89	23.97	90.00
Thu 6/26/97 7:00		6,996.8	28.4	23.2	12.8	8.6	18.0	18.0	17,768,220	169,500	81	23.97	90.00
Thu 6/26/97 13:00		6,002.1	25.8	22.5	17.3	8.5	t8 .0	18.0	17,774,106	170,054	91	23.97	90.00
Fri 6/27/97 7:00		6,019.6	27.8	24.5	18.8	9.0	18.0	18.0	17,793,017	171,130	82	23.97	90.00
Fri 6/27/97 13:00		6,024.2	26.1	22.9	17.4	8.7	18.0	18.0	17,797,974	172,397	92	23.97	90.00
Sat 6/28/97 7:00		6,042.9	26.2	23.1	17.1	9.1	18.0	18.0	17,818,256	174,201	86	23.97	90.00
Sat 6/28/97 13:00		6,048.4	26.0	22.8	17,1	8.9	18.0	18.0	17,624,186	174,762	92	23.97	90.00
Sun 6/29/97 7:00		6,066.7	27.5	24.2	17.9	9.6	18.0	18.0	17,843,920	176,612	86	23.97	90.00
Sun 6/29/97 13:00		6,072.0	28.1	24.8	18.6	9.5	18.0	18.0	17,849,652	177,161	92	23.97	90.00
Mon 6/30/97 8:00		6,090.2	28.4	25.1	18,9	9.5	18.0	18.0	17,869,308	179,046		23.97	90.00
Mon 6/30/97 14:00		6,095.9	28.6	25.3	19.3	9.3	18.0	18.0	17,875,464	179,623		23.97	90.00
Tue 7/1/97 7:00		6,112.5	26.4	23.2	16.9	9.5	18.0	18.0	17,893,392	161,246		23.97	90.00
Tue 7/1/97 13:00		6,118.3	28.3	25.0	18.8	9.5	18.0	18.0	17,899,656	101,849		23.97	90.00
Wed 7/2/97 7:00		6,135.7	26.1	23.1	16.4	9.7	18.0	18.0	17,918,448	183,569		23.97	90.00
Wed 7/2/97 13:00		6,141.6	28.7	25.4	19.3	9.4	18.0	18.0	17,924,820	104,169		23.97	90.00
Thu 7/3/97 7:00		8,158.9	28.3	23.1	10.7	9.6	18.0	18.0	17,943,504	105,848		23.97	90.00
Thu 7/3/97 13:00		6,164.5	25.9	22.7	16.6	9,3	18.0	18.0	17,949,552	186,411		23.97	90.00
Fri 7/4/97 7:00		6,182.1	26.2	23.1	16.3	9.9	18.0	18.0	17,968,560	188,219		23.97	90.00
Fri 7/4/97 13:00		6,187.9	28.0	25.1	18.6	9.4	18.0	18.0	17,974,824	168,615		23.97	90.00
Sat 7/5/97 7:00		6,206.4	26.6	23.9	17.3	9.3	18.0	18.0	17,994,782	190,570		23.97	90.00
Sat 7/5/97 15:00		6,212.7	25.9	22.9	18.5	9.4	18.0	18.0	18,001,630	191,282		23.97	90.00
Sun 7/6/97 7:00		6,231.1	28.0	23.2	16.4	9.6	18.0	18.0	18,021,480	192,864		23.97	90.00
Sun 7/6/97 13:00		6,237.1	28.0	24.9	18.0	10.0	18.0	18.0	18,027,960	193,454		23.97	90.00
Mon 7/7/97 7:00		6,251.9	27.9	24.9	17.9	10.0	18.0	18.0	18,043,944	195,138		23.97	90.00
Mon 7/7/97 13:00		6,257.3	28.7	25.7	18.4	10.3	18.0	18.0	18,049,776	195,711		23.97	90.00
Tue 7/8/97 7:00	1	6,274.9	26.1	23.2	16.1	10.0	18.0	18.0	18,068,784	197,447	81	23.97	90.00

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	Cumulateliwe		Feed	Recirculation	Filtrate			Filtrate	Totalized*		Water		
1	Operating Time	Hour Run Pr	ressure	Pressure	Pressure		Feed Flow	Flow	Filtrate Flow	Flow	Temperatur	Flux	
Dale 🖁 Tíme	[hrs]	Meter	(psij	(psi)	(psi)	TMP [psi]	(ggpm)	(gpm	(gai)	Totalizer	[°F]	gpd/ft ²	Recovery %
Tue 7/8/97 13:00	2011.50	6,280.6	20.2	25.2	17.9	I 0. 3	18.0	18.0	18,074,940	196. 024	69	23.07	90.00
Wed 7/9/97 7:00	2029.10	6,298.2	27.7	24.9	16.3	Il.4	20.0	20.0	18,098,060	199,706	81	26.63	90.91
wed 7/9/97 13:00	2034.60	6,303.9	26.4	25.4	16.7	11.7	20.0	20.0	18,102,900	200,363	88	26.63	90.91
Thu 7/10/97 7:00	2052.30	6,321.4	27.2	24.3	15.1	12.1	20.0	20.0	18,123,900	202,260	62	26.63	90.91
Thu 7110197 13:00	2057.70	6,326.8	26. 1	23. 1	14. 2	11.9	20.0	20.0	18,130,380	202, 670	66	26.63	90.91
Fri 7/11/97 7:00	2075.50	6,344.6	27.4	24.6	14.7	12.7	20.0	20.0	18,151,740	204, 896	81	26.63	90.91
Frl 7/11/97 13:00	2061.20	6,350.3	20.2	26.3	16.0	12. 2	20.0	20.0	18,158,580	205, 544	88	26.63	90.91
Sat 7/12/97 7:00	2097.40	6,366.5	26.1	25.1	15.5	12.6	20.0	20.0	18,178,020	207, 412	84	26 63	90.91
Sal 7/12/97 13:00	2104.40	6,373.5	25.5	22.5	13.5	12.0	20.0	20.0	18,186,420	208, 056	92	26.63	90.91
. sun 7/13/97 7:00	2121.50	6,390.6	26.0	25.1	14.9	13.1	20.0	20.0	18,206,940	209, 946	81	26.63	90.91
Sun 7/13/97 13:00	2127.80	6.396.7	27.0	24.7	14.6	12.8	20.0	20.0	18,214,260	210, 497	92	26.63	90.91
Mon 7/14/97 7:00	2145. 20	6,414.3	27.0	25.1	13.8	14. 1	20.0	2g. o	ta. 235. 360	212,341	a2	26.63	90.91
Mon 7/14/97 13:00	2151.00	6,420.1	28.3	25.3	14.3	14.0	20.0	20.0	16. 242. 340	212, 990	88	26.63	80.01
Tue 7/15/97 7:00	2166. 30	6.437.4	27.6	25.0	12.0	14.9	20.0	20.0	18,263,100	214, 806	91	26.63	90.91
Tue 7/15/97 13:00	2174. 20	6,443.3	27.4	24.5	12.5	14.0	20.0	20.0	18,270,180	215,563	66	26.63	90.91
Wed 7/16/97 7;00	2191.70	6,460.8	27.6	24.7	12.1	15.4	20.0	20.0	18,291,180	217, 467	62	26.63	90.01
Wed 7/16/97 13:00	2197.40	6,466.5	26.1	25.1	12.2	15.9	20.0	20.0	18,298,020	216. 122	88	26.63	90.91
Thu 7/17/97 7:00	2214.90	6,4 84.0	27.7	24.0	10.9	16.6	20.0	20.0	18,319,020	220, 039	01	26.63	90.91
Thu 7/17/97 15:00	2218.50	6,487.6	26.2	25.3	19.7	9.5	20.0	20.0	18,323,340	220, 324	91	26.63	90.91
Fri 7/18/97 7:00	2234.30	6,503.4	27.5	25.0	16.4	9.1	20.0	20.0	18,342,300	222.067	et	26.63	90.91
Fri 7/18/97 13:00			27.1	24.3	16.0	9.1	20.0	20.0	10,538,220	222.696	88	26.63	so. 91
Sat 7/19/97 7:00	2257.40	6,526.5	27.6	25.1	19.1	9.7	20.0	20.0	18,370,020	224.665	80	26.63	00.91
sat 7/19/97 13:00	2263.40	6,532.5	27.6	24.6	19.3	0.3	20.0	20.0	18,377,220	225, 345	91	26.63	90.91
Sun 7/20/97 7:00	2291.10	8,550.2	27.5	24.7	18.3	9.2	20.0	20.0	18,398,460	227, 410	83	26.63	90.01
sun 7/20/97 13:00	2287.40	6,556.5	27.7	24.6	16.2	9.5	20.0	20.0	18,406,020	226, 129	91	26.63	90.91
Mon 7/21/97 7:00	2304.10	6,573.2	27.7	24.9	16.5	9. 2	20.0	20.0	16. 426. 060	230, 077	63	26.63	90.91
Mon 7/21/97 13:00	2309.00	6,579.0	27.7	25.2	16.3	9.4	20.0	20.0	18,433,020	230, 726	69	26.63	90.91
Tue 7/22/97 7:00	2327.20	6,596.3	26.3	23.6	16.6	9.7	20.0	20.0	18,453,780	232, 661	63	26.63	00.81
Tue 7/22/97 13:00	2333.10	6,602.2	29.2	25.3	16.6	0.6	20.0	20.0	18,460,860	233, 333	90	26.63	90.91
Wed 7/23/97 7:00	2350.60	6,619.6	27.6	24.6	17.4	10.1	20.0	20.0	18,481,740	235, 254	62	26.63	90.91
Wed 7/23/97 13:00	2356. 20	6,625.3	26.2	25.3	16.2	10.0	20.0	20.0	18,488,580	235.993	80	26.63	90.91
Thu 7/24/97 7:00	2373.90	6,643.0	26.3	23.5	16.2	IO. 1	20.0	20.0	16. 500. 620	237, 620	82	26.63	90.91
Th" 7/24/97 13:00	2379.90	6,648.9	27.4	24.6	17.3	IO. 1	20.0	20.0	18,516,900	236, 961	97	26.63	90.91
Fri 7/25/97 7:001 Fri 7/25/97 13:00	2396.00	6,666.0 6,671.7	27.4 28.3	24.6 26.3	16.5 17.3	10.0	20.0	20.0	18,537,420	240. 296 240. 020	92	26.63	90.91
	2402.60	6,689.2	28.3 27.7			11.0	20.0	20.0	18,544,260	240. 939	es 92	26.63	90.91
Sat 7/26/97 7:00	2420. 10			25.0	16.3	11.4	20.0	20.0	18,565,260	242.935	-	26.63	90.91
Sat 7/26/97 13:00	2425.60 2442-40	6,694.9	25.6 27.6	23.1	14.6	11.2 12.0	20.0 20.0	20.0	18,572,100	243, 474 245 501	69 62		90.91 80.0.1
Sun 7/27/97 7:00	2443. 40 2446 - 70	6.712.5 6,717.8	27.0 28.1	25.0 25.3	15.9	11.9	20.0	20.0 20.0	18,593,220 18,599,580	245. 501 246, 109	62 69	26.63	80.9 I
sun 7/27/97 13:00 Mon 7/28/97 7:w	2446. 70 2466 - 70				16. 2 15. 4						89	26.63	90.81
	2466. 70	6,735.8	27.7	24.9	15.4	12.3	20.0	20.0	18,621,180	246, 067		26.63	90.91
Mon 7/28/97 13:00	2472.20 2470 po	6,741.3 6,748.9	26.3	25.3	16.0	12.3	20.0 20.0	20.0	18,627,780	2,448,685	es	26.63	90.91
Tue 7/29/97 7:00	2479.80	6,748.9 6.764 0	27.5	24.7	14.7	12.9		20.0	18,636,900	250, 617	63		90.01
Tue 7/29/97 13:00	2495. 20	6,764.3	26.3	23.4	13. 5	12.6	20.0	20.0		251, 221	91	26.63	90.91

TABLE S-1 OPERATING DATA MEMCOA • PHASES I AND II

			Feed	Recirculati	on Filtrate			Filtrate	Totalized*		Water		
	Operating Time	Hour Run	Pressure	Pressure	Pressure		Feed Flow	Flow	Fillrate Flow	Flow	Temperatur	Flux	
Dale & Time	hrs	Meter	(psi)	(psi)	(psi)	TMP (psl)	[gpm]	[gpm]	gal	Totalizer	[°F]	[gpd/ft ²]	Recovery *
Wed 7/30/97 7:00	2512.80	6.782.0	27.5	24.6	13.7	13.8	20.0	20.0	18,676,620	253. 214	62	26.63	S0. 91
Ved 7/30/97 13:00	2518.50	6,707.0	28.2	25.3	14.6	13.6	20.0	20.0	18,683,340	253.646	89	26.63	90.91
Thu 7/31/97 7:W	2536.10	6,805.2	27.6	24.0	13.3	14.5		20.0	18,704,460	255, 769	62	26.63	90.91
Thu 7/31/97 13:00	2541.60	6,810.9	27.8	24.0	13.4	14.5	20.0	20.0	18,711,300	256. 418	92	26.63	90.91
Fri 8/1/97 7:00	2550. 30	6,828.4	27.6	24.7	12.2	15.4	20.0	20.0	18,732,300	256, 301	63	26.63	90.91
Frl 8/1/97 13:00	2564.90	6,834.0	26.2	25.6	12.5	15.7	20.0	20.0	18,739,020	256. 034	88	26.63	90.81
Sat 8/2/97 7:00	2682.60	8,851.7	28	26.3	11.0	17.0	20.0	20.0	18,760,260	260, 621	63	26.63	90.91
Sat 8/2/97 13:00	2566. 20	6,855.3	27.9	25.2	20.2	7.7	20.0	20.0	18,764,580	261.099	67	26.63	90.91
Sun 8/3/97 7:00	2603.00	6,873.0	27.8	25.2	18.4	6.5	20.0	20.0	18,785,820	263. 032	62	26.63	90.91
Sun 8/3/97 13:00	2609,30	6,878.4	26.2	26.4	20.0	6. 2	20.0	20.0	18,792,300	263,711	00	26.63	90.91
Mon 8/4/97 7:00	2627.10	6,896.2	27	24.3	16.5	6.5	20.0	20.0	18,813,660	265.617	81	26.63	90.91
Mon 8/4/97 woo	2632.60	6,901 .o	26.5	25.6	20.2	8.3	20.0	20.0	18,820,500	266, 252	88	26.63	so. 91
Tue 8/5/97 7:00	2650. 30	6,919.4	28.9	25.5	10.7	8.9		20.0	18,841,500	268,198	61	26.63	90.91
Tue 8/5/97 13:00	2655.90	6,925.0	28.5	25.6	19.7	8.8	20.0	20.0	18,848,220	266, 812	88	26.63	SO. 91
Wed 8/6/97 7:00	2673.50	6,942.6	28.1	25.3	16.6	0.3	20.0	20.0	18,869,340	270, 691	62	26.63	S0. 91
Wed 8/8/97 13:00	2670. 30	6,946.4	26	23.3	17.1	8.9	20.0	20.0	18,876,300	271.269	91	26.63	90.01
Thu 8/7/97 7:00 1	2696.70	6,965.8	28.2	25.5	18.3	0.0	20.0	20.0	18,897,180	273, 147	82	26.63	90.91
Thu 8/7/97 13:00	2702.40	6,971.5	26	23.2	16.2	9.0	20.0	20.0	18,904,020	273, 776	01	26.63	90.91
Frl 8/8/97 7:00	2720. W	6,989.1	28.1	25.4	17.3	10.6	20.0	20.0	18,925,140	275.740	82	26.63	90.91
Fri 8/8/97 13:00	2725.50	6,994.6	26	23.3	15.5	10.5	20.0	20.0	18,931,740	276, 340	01	26.63	90.91
Sat 8/9/97 7:00	2742.90	7,012.0	27.1	24.3	15.3	11.8	20.0	20.0	18,952,620	276. 329	62	26.63	90.91
Sat 8/9/97 13:00	2746.40	7,017.5	27.6	24.7	16.4	11.2	20.0	20.0	18,959,220	276, 071	91	26.63	00.01
sun 8/10/97 7:00	2766. 20	7,035.3	28	25.2	15.6	12.4	20.0	20.0	18,980,580	260, 615	81	26.63	90.01
sun 8/10/97 13:00	2771.90	7,041.0	20.6	25.6	16.4	12.2	20.0	20.0	18,987,420	261.453	04	26.63	90.91
Mon 8/11/97 7:00	2789.40	7,058.5	28.2	25.6	14.6	13.6	20.0	20.0	19,008,420	263, 327	82	26.63	90.91
Aon 8/11/97 13:00	2785.10	7,064.2	26.5	25.6	15.2	13.3		20.0	19,015,260	263,956	69	26.63	90.91
Tue 8/12/97 7: W	2617.60	7,086.7	26.1	25.2	13.7	14.4	20.0	20.0	19,042,260	285,824	81	26.63	90.91
lua 8/12/97 13:00	2818.30	7,087.4	26.6	25.6	14.5		20.0	20.0	19,043,100	266, 456	91	26.63	90.91
Wed 8/13/97 7:00	2835.60	7,104.9	27.0	25.0	11.6	16.3	20.0	20.0	19,064,100	266, 265	82	26.53	90.01
Ved 8/13/97 13:00	2641.60	7,110.7	25.0	23.0	II.0	14.9	20.0	20.0	19,071,060	288,843	91	26.63	90.91
Thu 8/14/97 7:00	2850. 10	7,128.2	27.9	25.3	10.0	17.0	20.0	20.0	19,092,060	290, 727	62	26.63	90.91
Thu 8/14/97 13:00	2664.70	7,133.0	26.2	23.4	9.7	16.5	20.0	20.0	19,098,780	291,339	91	26.63	90.91
In all the total					-17						• 1		

Notes:

Flux = Filirate flow/membrane area Recovery - amount of feed water converted to filirate (product water) Recovery - amount of water produced /(amount of water produced + backwash) Recovery = Filtrate Vol/(Filtrate vol. + Backwash vol) Backwash Vol = sweep vol + Filirate exhaust Membrane Area based on Outer diam = 33.5 m² per module

TABLE B-2 OPERATING DATA ZEEWEED - PHASE I

	Recorded Data						EEWEE		PHASE								Calc	ulated	Data	*****
Date & Time	Cumulative Operating Time [hrs]	Temperatúre (°F)	Sprayer Pump Pressure [psi]	Vacuum Before Backpuise [in Hg]	Vacuum After Backpuise [in Hg]	Permeate Rate Before Backpulse [ipm]	Permeate Rate After Backpulse [lpm]	Backpulse Pressure [psig]	Backpulse Cartridge Pressure Inlet [psig]	Backpulse Cartridge Pressure Outlet [psig]	Backpulse Frequency [min]	Backpuise Duration [sec]	Permeate Rate to Drain [tpm]	Permeate Totalizer [gal]	Bleed Rate [ipd]	Recovery %	vr Fiow [scfm]	TMP [psi]	Permeate Rate Before Backpulse [gpm]	Flux [gpd/ft ²]
Mon 4/14/97 8:30	0.00	65	05	<u>> m</u> 8.5	<u>- 8.0</u>	13.0	<u>µ. q</u>			աս	<u>[44]</u> 5	10	6.00	2,054.5		97.13	8.50			
Mon 4/14/97 13:30	5.00	65		8.0	8.5	13.0					5	IO	6.00	2,102.1		96.48			3.43	32,97
Tue 4/15/97 10:00	25.50	62		7.6		13.0					5	10	8.00	2.308.6		96.70			3.43	32.97
Tue 4/15/97 13:30	28.00	62		7.5	6.0						5	IO	0.00	2,342.4		96.54			3.43	32.87
Wed 4116197 8:30	48.00	74		6.6		13.0					6	10	6.00	2,530.2		87.13			3.43	32.97
Wed 4/16/97 13:30	53.00	74		7.5	5.5	13.0					5	I 0	6.00	2,582.3	320	86.43	7.25	3.66	3.43	32.97
Th" 4/17/97 8:30	72. w	78		7. 0	6.6	13.0					6	I 0	6.00	2,769.3	260	87.06	7.26	3.44	3.43	32.87
Th" 4/17/97 11:45	75.25	76		6.0	6.0	13.0					5	I 0	6.W	2,626.0	305	86.68	7.25	2.95	3.43	32.97
Fri 4/18/97 8:30	96.00	64	26.0	6.6	6.0	13.0	13.0	7.6	15	10.0	5	I 0	6.00	3,009.9	265	97.02	7.75	4.17	3.43	32.97
Fri 4/18/97 13:30	101.00	76	26. 0	8.0	6.0	13.0	13.0	7.3	14	10.0	5	I 0	6.00	3,065.1	320	86.43	7.50	3.83	3.43	32.97
Sat 4/19/97 8:30	120.00	76	27.0	8.0	6.5	13.0	13.0	7.3	15	10.0	5	10	6.00	3.259.2	275	96.92	7.50	3.83	3.43	32.87
Sat 4/19/97 12:30	124.00	79	20.0	7.5	6.5			7.4	13	9.0	5	I 0	6.00	3,295.5	320	96.43	7.50	3.66	3.43	32.87
Sun 4/20/97 8:00	143. 50	78	27.0	7.5	6.0	13.0	13.0	7.3	14	10.0	5	I 0	6.00	3,490.8	265	96.61	7.50	3.66	3.43	32.97
Sun 4/20/97 12:30	148.M)		25.0	7.0		13.0		7.3	14	9.0	5	I 0	6.00	3,536.0		88.43			3.43	32.97
Mon 4/21/97 8:00	167.50	76	25.4	7.6		13.0			15	10.0	5	I O	6.00	3,732.9		96. 70			3.43	32.97
Mon 4/21/97 13:30	173.00		24.0	7.0		12.6			13	6.0	5	I O	6.00	3,787.2		86.61			3.30	31.70
Tue 4/22/97 8:4!5	192.25	3	25.0	7.O	6.0			7.3	14	10.0	5	I O	6.00	3,981.7		96.61			3.43	32.97
Tue 4/22/97 13:30	197.00		23. 0	7.5			13.0		12	7.0	5	I O	6.00	4,029.6		96.46			3.43	32.97
wed 4/23/97 8:15	215.75	77	26.0	7.0	6.0			7.4	15	11.0	5	IO	6.25	4,220.3		88.77			3.17	30.43
Wed 4/23/97 13:30	221.00	62	25.0	7.5				7.3	14	9.0	5	IO	6.25	4,273.8		96.67			3.57	34.24
Thu 4124197 8:30	240.00	76	26.0	9.0				7.3	11	15.0	5	I O	6.25	4,467.1		96.66			3.17	30.43
Thu 4/24/97 14:00	245.50		25.0	8.0	7.0		13.5		10	14.0	5	10	6.25	4,523.6		96.62			3.57	34.24
Frl 4/25/97 8:00	263. 50		26.0	6.5	7.0	13.5		7.5	10	15.0	5	IO	6.25	4,707.5		86.77			3.57	34.24
Fri 4/25/97 14:30	270.00	85	25.0	7.0	6.5			7.6	9	13.0	5	IO	6.25	4,773.3		96.41			3.57	34.24
Sat 4/26/97 8:00	267.50	77	26.0	9.0			13.0		11	15.0 14.0	5	I O	6.00	4.952.2		96.81			3.43	32.97
Sat 4/26/97 12:30 sun 4/27/97 8:30	292.00	60 70	25. 0	9.0	7.0 7.0			7.6 7.5	10 11	14.0	5 5	I 0 I 0	6.00	4,998.0		96.43			3.43	32.97
sun 4/27/97 8:30 Sun 4/27/97 12:30	312.00	70 72	26. 0 26. 0	9.0 9.0					10	15.0	э 5		6.00 6.W	5,206.5 5,233.7		96.43 96.40			3.43	32.97
Mon 4/28/97 8:00	316.00 335.50	71	26. 0 27. 0	9.0 I0.5	7.0 8.0		13.0 13.0	7.5	12	16.0	э 5	I 0 I 0	6.00	5,434.1		96.46			3.43 3.43	32.97 32.97
Mon 4/28/97 13:00	340.50		24. 0	10. 5		13.5			9	14.0	6		6.25	5.465.5		06.46			3.43	34.24
Tue 4/29/97 8:4:5	360.26	74	24. 0 26. 0	10.0 10.0				o. u 7. 6	11	16.0	5	10	6.25 6.25	5,686.1		96.62			3.57 3.70	34.24 35.51
Tue 4/29/97 13:30	360.26	83	20.0 24.0	a. 0				6.0	9	13.0	5	10	6.20 6:00	5.735.0		96.27			3.70 3.43	33.31 32.97
Wed 4/30/97 8:010	363.50	79	24.0 27.0	a. u 9. 0				0.0 7.6	10	15.0	5	IO	6.00	5.907.2		96.59			3.43 3.43	32.97 32.97
Wed 4610197 14;010	369.60		27.0 25.0	9.0				7.7	9	13.0	5	IO	6.00 6.00	5,962.1		96.43			5.45 3.43	32.97 32.87
Thu 5/1/97 8:010	407.50	1	20. 0 26. 0	9.0			13.0		10	14.0	5		6.25	6.150.7					5.45 3.43	32.87
Thu 5/1/97 14:00	413.50	84	25.0	6.5	7.0	13.0				13.0	5			.211.6 33						
114 0/1/0/ 17/0/0		101	~J. J	0.0		10.0	10.0	, ,,,		13.0	J	10	0. 20 0		,, QL	6 VE-		/	0.10	5w. 01

							OPER		ы-z i DAT	Δ										
							EEW		HAS											
Date & Time	Cumulative Operating Time [hrs]	sture (°	sprayer Hump Pressure [psi]	Vacuum Belore Backputse [in Hg]	Vactum After Backpulse [in Hg]	Permeate Rate Before Backpulse [lpm]	Permeate Rate Atter Backpulse [lpm]	Backpulse Pressure [psig]	Backpulse Cartridge Pressure Intet (psig)	Backpulse Cartridge Pressure Outlet [psig]	Backpulse Frequency [min]	Backpulse Duration [sec]	Permeate Rate to Drain [Ipm]	Permeate Totalizer [gal]	Bieed Rate [ipd]	Recovery %	Air Flow [sctm]	TMP [psi]	Permeate Rate Before Backpulse [gpm]	Flux [gpd/ft ²]
Fri 5/2/97 8:30	432.00	85 2	26,0	7.5	6.5	13.0	13.0	7.6	10	14.0	5	10	6.25	B,284.5		96.72	7.50		3.43	32.97
Fri 5/2/97 13:30	437.00		24. 0	8.0	7.0	13.0	13.0	8.0	9	13.0	5	10	6.00	6,335.1		96.32			3.43	32.97
Sat 5/3/97 8:30	456.00	1	25.0	8.0		13.0	13.0	7.6	I O	15.0	5	10	6.00	6,527.3		86.54			3.43	32.97
Sal 5/3/97 1 1:30	459.00			9.0		13.0	13.0	7.8	10	15.0	5 5		6.00	6,555.1 6,269.9		96.43			3.43	32.91
Sun 5/4/97 8:00	479.50	-	27.01 25.0			13.0	13.0 13.0	8.4 6.2	11 1 0	16. 0 14. 5	5	I 0 1 0	6.W 6.W	6,815.2		96.43 95.32			3.43 3.43	32.97 32.91
sun 5/4/97 12:30 Mon 5/5/97 7:30	464. 00 503. 00			9. 5 10. 0		13.0 13.5	13.0	0. 2 6. 4	11	14. 5 16. 0	5	10	6.W	7. W6. 8		95.32 86.37			3.43 3.57	34.24
Mon 5/5/97 13:30	503.00 508.00		25.0			13.5	13. 5 13. 6	0.4 8.4	10	10.0	5	10	6.W	7.069.2		98.43			3.57	34.24
Tue 5/6/97 7:30	527.00		26.01			13. J 13. 0	13.0	8.1	11	15.0	5	10	6. W	7.252.5		85.58			3.43	32.97
Tue 5/6/97 13:30	533.00		25.01			13.0	13.0	6.0	10	14.0	5	10	6.00	7,313.5		86.37			3.43	32.91
Wed 5/7/97 8:00	551.50		27.0 1			13.0	13.0	6.1	11	15.0	5	10	6.00	7.582.7		96.59			3.43	32.8;
Wed 5/7/97 14:00	557.50	1	26.0 1			13.0	13.0	6.0	10	14.0	5	10	6.00	7.563.3		96.43			3.43	32.97
Thu 5/8/97 7:30	575.00	78 2	27.0 1	0.5	8.0	13.0	13.0	6.2	11	15.0	5	10	6.26	7.742.4	320	96.57	7.75	5.16	3.43	32.97
Thu 5/8/97 14:00	581.50	84 2	26.0 1	l 0. 5	8.0	13.0	13.0	8.2	10	14.0	5	10	6.00	7,803.9	325	~96. 37	7.50	5.15	3.43	32.81
Fri 5/9/97 7:30	599.00	62 2	26.0 1	1.0	9.5	13.0	13.0	8.2	11	15.0	5	10	6.W	7,987.5	305	96.59	7.50	5.40	3.43	32.91
Fri 5/9/97 13:00	604.50	64 2	2 8.0 1	l 0. 5	8.5	13.0	13.0	6.2	10	15.0	5	10	8.25	0,083.9	320	86.57	7.5 0	5.16	3.43	32.97
Sal 5/10/97 7:30	623.00	78 2	26.0 1	l 0. 0	9.0	13.0	13.0	6.2	11	15.0	5	10	6.00	8,193.4	315	96.45	7.5 0	4.81	3.43	32.9;
Sa 5110197 14:00	629. 50	71 2	26.0 1	l 0. 0	9.0	13.0	13.0	6.0	11	15.0	5	10	6.W	0,206.8	310	86.54	7.50	4.81	3.43	32.97
Sun 5/11/97 7:30	647. W			6.5		13.0	13.0	6.0	11	15.0	5	10	6.W	61216.5		96.46			3.43	32.97
sun 5/11/97 13:30	653.00	E C		6.0		13.0	13.0	6.0	I O	14.0	5	10	6.00	0,270.3		95.54			3.43	32.97
Mon 5/12/97 7:30	671.00		26.0			13.0	13.0	6.2	10	14.0	5	IO	6.25	8,431.0		96.67			3.43	32.81
Mon 5/12/97 13:30	677.00					13.0	13.0	8.4	9	13.0	5 5	10	6.25 e.00	8,491.4		86.51			3.43	32.97 32.97
Tue 5/13/97 7:30 Tue 5/13/97 13:30	685.00 701,00	1	27.01 25.01			13.0	13.0	8.6 6.2	11	15.0	5	10 10	6.00 6.00	8,675.1 8,735.8		96.43 96.54			3.43 3.43	32.91
Tue 5/13/97 13:30 Wed 5/14/97 6:00		_	26. 0			13.0	13.0 13.0	6.2 8.4	10 11	14.0 15.0	5	10	6.W	8.841.2		96.59			3.43 3.43	32.91 32.97
Wed 5/14/97 6:00	719. 50 724. 75			9. U 9. 5		13.0 13.0	13.0	6.4 6.4	9	13.0	5		6.00	8.895.0		96.39 96.32			3.43 3.43	32.97
Thu 5/15/97 7:30	743,00			9. J 9. O		13. 0 13. 0	13.0	6.6	3 11	14.0	5	10	6.W	9.016.5		96.46			3.43	32.97
Thu 5/15/97 15:00	750. 50	1	24.0	9.5		13.0	13.0	6.6	9	14.0	5	IO	6.00	9,091.1		96.32			3.43	32.97
Frl 5/16/97 8:00	767.50		26.0	9.0		13.0	13.0	6.4	11	16.0	5	10	8.00	9,148.1		96.32			3.43	32.97
Fri 5/16/97 13:00	772.50	83 2	24.0	9.5	8.5	13.0	13.0	8.0	10	15.0	5	10	6.00	9,194.2	330	96.32	7.50	4.67	3.43	32.97
Sat 5/17/97 8:00	791'50	80	25.0	9.0	9.6	13.0	13.0	8.0	11	16.0	5	10	6.00	9,384.9	315	96.46	7.50	4.42	3.43	32.97
Sal 5/17/97 12:30	796.00	83 2	25.0	9.0	10. 0	13.0	13.0	9.0	10	15.0	5	10	6.00	9,425.6		96.43			3.43	32.93
sun 5/18/97 8:00	615.50	1	24.0 1		10. 0		13.0	8.0	11	16.0	5	10	6.00	9,624.9		96.54			3.43	32.97
Sun 5/18/97 12:30	820.00		25.0	9.0	10.0	13.0	13.0	8.0	10	15.0	5	10	6.00	9,663.8		86.46			3.43	32.97
Mon 5/19/97 7:30	839.00	4		10.0		13.0	13.0	7.2	II	17.0	5	10	6.00	9,734.0		96.75			3.43	32.97
Mon 5/19/97 13:00	644. 50 962 00			1.0	10.5	13.0	13.0	7.6	10	16.0	5	10	6.00	9,790.0		95.27			3.43	32.91
Tue 5/20/97 7:30	863.00	82 3	24.0	12.0	11.0	12.0	12.0	7.8	12	17.0	5	10	6.00	9,976.1	260	96.66	7.75	5.69	3.17	30.4:

TABLE B-2

TABLEB- 2 OPERATINGDATA ZEEWEED - PHASE |

Date & Time Durantic Ling Ling <thling< th=""> <thling< thr=""> Ling</thling<></thling<>	×niii 300.433 302.437 32.97 31.70 32.97 31.70 32.97 31.70
Date 2 fine $O_1 = 0$ <td>30.43 30.43 32.97 32.97 32.97 31.70 32.97 32.97 32.97</td>	30.43 30.43 32.97 32.97 32.97 31.70 32.97 32.97 32.97
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	30.43 30.43 32.97 32.97 32.97 31.70 32.97 32.97 32.97
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	30.43 30.43 32.97 32.97 32.97 31.70 32.97 32.97 32.97
Wed 5/21/97 7:30 887.00 52 24.0 13.5 12.5 12.0 12.0 5.4 11 17.0 5 10 5.00 10,217.8 310 98.64 7.25 8.63 8.17 ved 5/21/97 14:00 593.50 56 23.0 13.5 12.5 13.0 13.0 7.5 11 17.0 5 10 6.00 10,217.8 310 98.64 7.26 8.63 8.17 ved 5/21/97 14:00 53 24.0 12.0 13.0 13.0 7.5 11 17.0 5 10 6.00 10,217.8 310 98.64 7.26 8.63 8.17 Thu 5/22/97 7:30 911.00 53 24.0 12.0 13.0 13.0 5.2 12 15.0 5 10 5.00 10,368.9 305 95.59 7.75 5.9 3.43 Thu 5/23/97 13:00 93.5 13.0 12.0 13.0 7.4 11 17.0 5 10 5.00	30 43 32. 97 32. 97 32. 97 31. 70 32. 97 32. 97 32. 97
Ved 5/21/97 14: oo 593.50 56 23.0 13.5 12.5 13.0 13.0 7.5 11 17.0 5 10 6.00 10,282.9 325 95.37 7.50 5.53 3.43 Thu 5/22/97 7:30 911.00 53 24.0 12.0 11.0 13.0 5.2 12 15.0 5 10 5.00 10,368.9 305 95.59 7.75 5.59 3.43 Thu 5/22/97 13:00 915.50 55 23.0 13.0 12.0 13.0 7.4 11 17.0 5 10 5.00 10,368.9 305 95.59 7.75 5.93 3.43 Frit 5/23/97 8:00 935.50 51 25.0 13.0 12.0 13.0 7.4 11 17.0 5 10 5.00 10.424.3 325 95.37 7.50 5.39 3.43 Frit 5/23/97 8:00 935.50 51 25.0 13.0 12.0 12.5 7.5 12 15.0 5 </td <td>32. 97 32. 97 32. 97 31. 70 32. 97 32. 97 32. 97</td>	32. 97 32. 97 32. 97 31. 70 32. 97 32. 97 32. 97
Thu 5/22/97 7:30 911.00 53 24.0 12.0 11.0 13.0 5.2 12 15.0 5 10 5.00 10.368.9 305 95.59 7.75 5.59 3.43 Fhu 5/22/97 13:00 915.50 55 23.0 13.0 12.0 13.0 7.4 11 17.0 5 10 5.00 10.424.3 325 95.37 7.50 5.39 3.43 Fri 5/23/97 8:00 935.50 51 25.0 13.0 12.0 12.5 7.5 12 15.0 5 10 5.00 10.424.3 325 95.37 7.50 5.39 3.43 Fri 5/23/97 8:00 935.50 51 25.0 13.0 12.5 12.5 7.5 12 15.0 5 10 6.00 10' 554.3 310 95.54 7.50 5.39 3.43 Fri 5/23/97 14:30 942.000 54	32. 97 32. 97 31. 70 32. 97 32. 97
Thu 5/22/97 13:00 915.50 55 23.0 13.0 12.0 13.0 7.4 11 17.0 5 10 5.00 10.424.3 325 95.37 7.50 5.39 3.43 Fri 5/23/97 8:00 935.50 51 25.0 13.0 12.0 12.5 12.5 7.5 12 15.0 5 10 6.00 10' 554.3 310 95.54 7.75 5.39 3.30 Fri 5/23/97 14:30 942.00 54 25.0 13.0 12.0 13.0 7.5 12 15.0 5 10 5.00 10.643.2 310 95.54 7.50 5.39 3.43 Fri 5/23/97 14:30 942.00 54 25.0 13.0 12.0 13.0 7.5 12 15.0 5 10 5.00 10.643.2 310 95.54 7.50 5.39 3.43	32. 97 31. 70 32. 97 32. 97
Fri 5/23/97 8:00 935.50 51 25.0 13.0 12.5 12.5 7.5 12 15.0 5 10 6.00 10' 554.3 310 95.54 7.75 5.39 3.30 Fri 5/23/97 14:30 942.00 54 25.0 13.0 12.0 13.0 7.5 12 15.0 5 10 5.00 10,643.2 310 95.54 7.50 5.39 3.43	31. 70 32. 97 32. 97
Fri 5/23/97 14:30 942.00 54 25. 0 13. 0 12. 0 13.0 13.0 7.5 12 15.0 5 10 5. 00 10,643.2 310 95. 54 7. 50 5. 39 3. 43	32. 97 32. 97
	32.97
Sat 5/24/97 13:00 954.50 55 25.0 13.0 12.0 12.5 13.0 7.5 12 15.0 5 10 5.00 10.739.9 325 95.37 7.50 5.39 3.30	
Sun 5/25/97 8:00 953.50 52 25.0 13.0 12.0 13.0 13.0 7.4 12 15.0 5 10 6.00 10.893.2 315 95.48 7.50 5.39 3.43	32.97
Sun 5/25/97 13:00 958.50 55 25.0 13.0 12.0 13.0 13.0 7.5 12 15.0 5 10 6.00 10,920.6 320 95.43 7.50 5.39 3.43	32.97
Mon 5/26/97 8:00 1,007.50 52 25.0 13.0 12.0 13.0 13.0 7.4 12 15.0 5 10 5.00 11,081.7 315 95,48 7.50 5.39 3.43	32.97
Ann 5/26/97 13:30 1,013.00 55 24.0 13.0 12.0 13.0 13.0 7.5 10 24.0 5 10 5.00 11,109,1 315 95.48 7.50 5.39 3.43	32.97
Tue 5/27/97 7:30 1,031.00 57 25.0 13.0 12.5 12.0 12.0 7.6 12 15.0 5 10 5.00 11,246.5 310 95.54 7.50 5.39 3.17	30.43
Fue 5/27/97 13:00 1,036.50 59 23.0 13.5 12.5 12.0 12.0 7.5 11 17.0 5 10 5.00 11.302.0 325 95.37 7.25 6.53 3.17	30.43
Wed 5/28/97 5:00 1,055.50 53 24.0 13.0 12.5 12.5 12.5 7.8 12 19.0 5 10 5.00 11,381,0 315 95.45 7.75 5.39 3.30	31.70⊺
/ed 5/28/97 14:00 1,061.50 67 24.0 14.0 13.0 12.5 12.5 5.0 11 17.0 5 10 5.00 11.437.3 325 95.43 7.25 6.55 3.30	31.70
Thu 5/29/97 7:30 1.079.60 56 25.0 13.0 12.5 12.5 12.5 5.5 12 15.0 5 10 6:00 11.455.7 320 96.43 7.50 5.39 3.30	31.70
Fine 5/29/97 13:00 1,084.50 57 23.5 14.0 12.5 12.5 12.5 7.6 11 17.0 5 10 5.00 11,540.6 325 95. 37 7. 25 6.88 3.30	31.70
Fr 5/30/97 7:30 1,103.00 85 25.0 13.5 13.0 13.0 13.0 5.2 11 15.0 5 10 6.00 111555.2 320 95.43 7.50 5.53 3.43	32.97
Fr 5/30/97 13:00 1,108.50 57 24.0 14.0 13.5 13.0 13.0 5.0 11 17.0 5 10 5.00 11.720.2 325 95.37 7.25 5.55 3.43	32.97
Sal 5/31/97 5: 00 1,127.50 64 25.0 14.0 13.0 13.0 13.0 5.2 12 15.0 5 10 5.00 11,829.0 320 95.43 7.25 5.55 3.43	32.97
Sal 5/31/97 13:00 1. 132. 50 67 24. 0 14. 0 13. 5 13. 0 13. 0 5.1 11 17. 0 5 10 6.00 11.881.5 315 95. 45 7. 25 6. 55 3. 43	32.97
sun 6/1/97 8:00 1,151.50 61 25.0 14.0 13.0 13.0 13.0 7.5 11 15.0 5 10 5.00 11,973.2 320 95.43 7.25 5.55 3.43	32.97
sun 6/1/97 13:00 1,156.50 66 25.0 14.0 13.0 13.0 13.0 5.0 11 17.0 5 IO 5.00 12,024.8 320 95.43 7.50 5.55 3.43	32.97
Mon 6/2/97 7:30 1,175.00 64 25.0 14.0 13.5 13 13 5.4 13 19 5 10 5.00 12101.2 310 85.54 7.75 5.55 3.43	32.97
Mon 6/2/97 13:00 1,180.50 56 23.0 14.5 14.0 13 13 7 11 15 5 IO 5.00 12155.1 325 85.37 7.50 7.12 3.43	32.97
Tue 6/3/97 7:30 1,199.00 52 25.0 15.5 15.0 13 13 7.5 12 15 5 IO 5.w 12337.4 305 95.59 7.75 7.51 3.43	32.97
Tue_6/3/97 14:00 1. 205. 50 66 24. 0 15. 0 14. 5 14 14 7. 5 11 18 5 10 12403. 2 330 95. 32 7. 50 7. 37 3. 70	35.51
Wed 6/4/97 7:30 1.223.00 91 25.0 16.6 15.5 14 14 6.4 12 19 5 10 6.00 12561.1 320 96.43 9.W 5.10 3.70	35.51
Wed 6/4/97 13:00 1,228.50 88 23.0 17.0 15.0 13 13 8 11 15 5 10 6.00 12616.7 335 95.27 7.50 5.35 3.43	32.97
Thu 6/5/97 7:30 1,247.00 53 25.0 16.0 15.0 13.5 13.5 9.4 13 19 5 10 6.00 12713.9 315 96.48 6.25 7.56 3.57	34. 24
Thu 6/5/97 13:00 1.25250 89 23. 0 17. 0 18.0 13. 5 13. 5 7. 5 11 18 5 10 6. 00 12755. 4 320 95. 43 7. 50 5. 35 3. 57	34. 24
Fri 6/6/97 7:30 1,271.00 63 24.0 17.5 15.5 13 13 6.2 12 20 5 10 6.00 12927.7 320 96.43 5.00 6.50 3.43	32.97
Frí 6/6/97 13:00 1.276.50 89 24.0 17.0 16.0 14 14 7.8 12 19 5 10 5.00 12970.3 325 95.55 7.25 6.35 3.70	35.51
Sat 6/7/97 5:00 1,295.50 52 24.0 16.5 16.0 13 13 7.5 12 15 5 10 5.00 13052.7 320 05.74 7.50 8 10 3.43	32.97
Sai 6/7/97 13:00 1,300.50 89 24.0 17.0 16.0 13 13 5.1 12 19 5 10 5.00 13105.4 325 95.56 7.75 6.35 3.43	32.97

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APP-13

TABLE B-2 OPERATING DATA

							LEEW E	:IED +	PHAS								_			
Dale. 5 Time	Cumulative Operating Time [hrs]	Temperature [*	Sprayer [psi]	Vacuum Backputs	Vacuum A Backpulse	Permeate Rate Before Backpulse [lpm]	Permeate Rate Atter Backpulse [lpm]	Backpulse Pressure [psig]	Backpulse Cartridge Pressure Intet [psig]	Backpuise Cartridge Pressure Outlet [psig]	Backputse Frequency [min]	Backpuise Duration [sec]	Permeate Rate to Drain [tpm]	Permeate Totalizer [gal]	Bleed Rate [lpd]	Recovery %	Air Flow [scfm]	TMP [psi]	Permeate Rate Before Backpulse [gpm]	Flux fand/ff²1
sun 6/8/97 8:0	1,319.50	1		16.0	16.0	13	13	6	12	10	5	10	5.00	13164.1			7.50	7.86	3.43	32.9
Sun 6/8/97 13:0	1,324.50	67	25.0	16.0	16.0	13.5	13.5	8.2	12	16	5	10	5.0CI	13201.8	315	95.81	7.50	7.86	3.57	34.2
Mon 6/9/97 7:3	1,343.W	188 2	25. O	15.0	14.5	14	14	7.9	13	20	5	10	5.00	13267.1	300	96.00	8.00	7.37	3.70	\$5.5
Mon e/S/S7 13:3	1,349.00	89 2	24.0	18.0	15.0	14	14	6	12	18	5	10	4.W	13315.7	325	94.66	7.75	7.66	3.70	35.5
Tue 6/10/97 7:3	1,367.00	84 2	26.0	15.5	14.5	14.5	14.5	5.1	13	20	5	I 0	4.00	13391.6	325	94.66	7.75	7.61	3.63	36.7;
lrue 6/10/97 13:3	1,373,00	91 5	24.0	1 6 .0	15.0	14	14	7.6	12	17	5	10	4.00	13426.6	320	94.74	6. W	7.66	3.70	35.5
Wed 6/11/97 7:3	1,391.00	85 5	24.0	16.0	15.0	14	14	6	13	20	5	10	4.00	13564.9	320	94.74	7.75	7.66	3.70	35.5'
Wed 6/11/97 13:3	1.397.00	93	24.0	16.0	15.0	14	14	7.9	12	18	5	10	4.W	13601.9	325	94.66	8.00	7.66	3.70	35.5
Thu 6/12/97 7:3	1,415.00	84	24.0	15.0	15.0	14	14	6	13	18	5	10	4.W	13656.2					3.70	35.5
Thu 6/12/97 13:0	1,420.50																			
Fil 6/13/97 7:3	1.439.00	63 2	24.0	15.0	15.0	12	12	7.9	12	20	6	10	4.00	13716.3	320	94.74	7.75	7.37	3.17	30.4:
Frl 6/13/97 13:3	1,445.00	92		15.0	15.0	12	12	8	12	20	5	10	4.00	13734.7	315	94.51	7.75	7.37	3.17	30.4:
Sal 6/14/97 7:3	1,463.00			15.0	15.0	12	12	8	12	20	5	10	4.00	13756.6		94.74			3.17	30.4:
Sat 6/14/97 13:3	1,469.00			16.0	15.0	13	t3	7.9	11	19	5	10	4. W	13606.7				7.56	3.43	32.9;
sun 8 /15/97 7:3	1. 467. W			16.0	16.0	12	12	7.6	12	20	5	IO	4,00	13657.8		94.74				30. 4:
Sun 6/15/97 13:3		1.1.1	25.0	16.0			10 1		12	20	5			669.8 3						

Flux = Filtale flow/membrane area

Recovery - amount of leed water converted to filtrate (product water) Recovery - amount of water produced /(amount of water produced + bleed rate) Recovery = Permeate Rate to Drain/(Permeate Rate to Drain + Bleed Rate)

Backwash Vol = sweep vol + Filtrate exhaust

Membrane Area based on Outer diam = 150 ft²

TABLE DIS OPERATING DATA ZEEWEED PHASE

	6ug	Ē	Ĭ		a structs	de Rate Baciquise [[pm]	[md]	2	8.5	8	ncy	bn [sec]	to Draw	ir (gal)	(B	(%) Au			Ē		[Jom]	Ĵ	CO B	on Time	Time (d	
	Operaturg	Εd		e Ŧ	B	Hate Stoutse	Rame Putse (1	1950	Ë.	artrid thet (s		Duration	Rate to		e Vol	Recow	F		Rate croutee		S	(mgA.)	а О Ч	Retention		
	22				Atter	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	a ŭ	а. 3	8 u	200	5	5		at To	Waste	Daily R	(sctm)	<u>.</u>	Bach Bach		I I I I I I I I I I I I I I I I I I I	CBOD	- Line Line		Retention	8
	Cumulative Time (hts)	Tempera	k T	22		e e	9 8 9	i i	18 A			P	ermeate M)	2	e de	1 di 1 di	Flow	[bsd] d)	tore a	a fi	2	2	uor) Morte	tydrautic	Solio	L 0.
Date & Time		والمراجعة والمتكري		لهج	<u>ع د</u>	åå	s₹.	<u>8 6</u>	<u>م م</u>	القرقا	لعما	<u> </u>	<u>16 #</u>	ليبقي	<u> </u>	<u> </u>	ليتخيا	ليقبا	ំំំំំ	đ B	ă l	₽	<u>. 88 </u>			
Thu 6/19/97 7:30 Thu 6/19/97 13:30	0.00 6.00	• · ·	12.0 20.0	3.0 3.0	3.0 3.0	6.0 8.0	6.0 8.0 .	5.0 5.0	12 10	15 15	10 10	10 20	4.0 4.0	141,648 142,018	8.8 0	99.92	8.50 9.50	1.47	1.59	15.22				29 29	21	
Fri 6/20/97 7:30	24.00		20.0	3.0	3.0	8.0	8.0	5.0 5.0	10	16	10	20	4.0	143,344	8.8	00.02		1.47		20.29	14,100	251		29	2	1.03
Fil 6/20/97 13:30	30.00		20.0	3.0	3.0	8.0	8.0	5.0	10	16	10	20	4.0	143,719	0	99.92		1.47	2.11	20.29	•			29	-	
Sal 6/21/97 7:30	48.00		20.0	3.0	3.0	6.0	6.0	5.0	10	15	10	20	4.0	144,904	8.8			1.47	2.11	20.29				29	21	I
Sat 6/21/97 13:30	54.00		t0.0 17.0	3.0 3.0	3.0 3.0	8.0 8.0	0.0 8.0	5.0 8.0	11	15 15	10 10	20 20	4.0 4.0	145,322 146,664	0 8.8	89.92			2.11 2.11	20.29 20.29				29 29	21	
Sun 6/22/97 7:30 Sun 6/22/97 13:30	72.00 78.00		18.0	3.0	3.0	8.0	8.0	0.0 0.0	10	15	10	20	4.0	147,084	0.0 D	99.92			2.11	20.29				29	21	
Mon 6/23/97 7:30	96.00		7.0	4.0	4.0	8.0	8,0	8.0	11	15	10	20	4.0	148,304	8.6	•••••			2.11	20.29	13,040	670	145	29	21	0.96
Mon 6/23/97 13:30	102.00	84 1	15.0	3.0	3.0	0.0	8.0	7.0	11	14	10	20	4.0	148,703	0	99.92	9.50	1.47	2.11	20.29				2.9		
Tua 6/24/97 7:30	120.00		17.0	3.0	3.0	8.0	8.0	7.0	11	15	10	20	4.0	149,568	8.8			1.47		20.29				2.0	21	i
Tue 6/24/97 13:30 Wed 6/25/97 13:30	128.00 150.00		18.0 18.0	3.0 3.0	3.0 3.0	8.0 8.0	8.0 8.0	7.0 6.0	11	15 15	10 10	20 20	4.0 4.0	151.130	0 8.8	99.92			2.11	20.29	14,500	208	220	2.9 2.9		1.00
Wed 6/25/97 13:30	150.00		17.0	3.0	3.0	8.0	0.0 0.0	6.0 6.0	10	15	10	20	4.0	151,539	0.0	99.92			2.11	20.29	(4,500	200	220	29	21	1 1.00
Thu 6/26/97 7:30	168.00		17.0	3.0	3.0	8.0	0.0	6.0	11	14	10	20	4.0	162,688	7				2.11	20.28				2.9	20	3
Thu 6/26/97 13:30	174.00	92 1	17.0	3.0	3.0	8.0	8.0	6.0	10	15	10	20	4.0	153,085	0	89.94	7.00	1.47	2.11	20.29				2.9		
Fil 6/27/97 7:30	192.00		15.0	3.0	3.0	8.0	8.0	6.0	10	15	10	20	4.0	154,202	7				2.11	20.29	17,260	175	138	2.9	20	6 1.01
Fri 6/27/97 13:30	199.00		15.0	3.0	3.0	6.0	8.0	6.0	10	15	10	20	4.0	154,604	0	99.94	7.00			20.29				2.9		
Sat 6/26/97 7:30	218.00		15.0 14.0	3.0 3.0	3.0 3.0	8.0 8.0	8.0 8.0	6.0 8.0	10 10	15 15	10 10	20 20	4.0 4.0	155,695 155,947	7 0	99.94			2.11 2.11	20.29				2.9	26	5
Sat 6/28/97 13:30 Sun 6/29/97 7:30	222.00 240.00		14.0	3.0	3.0	8.0	8.0	7.0	10 10	15	10	20	4.0	155,695	7	89.84		1.47		20.28				29 29	26	
Sun 6/29/97 13:30	248.00		10.0	4.0	4.0	8.0	8.0	7.0	10	17	10	20	4.0	158.330	'	99.94			2.11	20.29	•			29		
Man 6/30/97 8:00	264.50		1.0	4.5	4.0	8.0	0.0	7.4	10	Ĥ	20	to	4.0	157,442	8				2.11	20.29	15,660	192	152	2.9	23	3 1.00
Mon 6/30/97 14:00	270.50	93	0.0	5.0	3.5	8.0	8.0	7.0	10	13	20	10	3.5	157,779	0	99.93	7.00	2.48	2.11	20.29				3.3		
Tue 7/1/97 7:00	287.50	63	0.0	4.5	4.5	0.0	0.0	7.8	12	14	20	10	3.5	159,925	11		8.00	2.21	2.11	20.29				3.3	17	7
Tue 7/1/97 13:00	293.50		11.0	4.5	4.0	8.0	8.0	7.4	10	13	20	10	4.0	159,335	0	99.90	7.50			20.29				2.9		
Wed 7/2/97 7:00	311.50		2.0 15.0	5.0 4.5	4.5 4.0	8.0 6.0	8.0 8.0	7.8 7.4	12 10	14 13	20 20	10 10	4.0 3:5	160,493 160,666	8 0	99.93	7.75		2.11	20.29 20.29	17,300	293	197	2.9	23	1 1.15
Wed 7/2/97 13:00 Thu 7/3/97 7:00	317.50 335.50		0.01	9.0 4.5	4.0	8.0	0.0	7.9	12	15	20	10	3.5	161.936	10	89.93			2.11	20.29				3.3 3.3	19	
Thu 7/3/97 13:00	341.50		50	4.5	4.0	8.0	8.0	7.8	11	13	20	10	3.5	162,290	0	99.90	10.00			20.29				33		•
Fri 7/4/97 7:00	359.50	84 1	4.0	5.0	5.0	8.0	8.0	8.4	12	15	20	10	3.5	163,350	10		10.25	2.46	2.11	20.29	15,700	319	210	3.3	(9	1.31
Fil 7/4/97 13:00	365.50		13.0	5.0	4.5	8.0	0.0	8.0	11	13	20	10	3.5	103,719	0	89.90	10.00			20.29				3.3		
Sat 7/5/97 7:10	383.67		13.0	5.0	5.0	8.0	0.0	8.0	11	15	20	10	3.5	164,727	10	~~ ~~			2.11	20.29				3.3	19)
Sai 7/5/97 13:30 Sun 7/6/97 7:30	390.00 408.00		11.0 13.0	5.0 6.0	5.0 6.0	8.0 8.0	8.0 8.0	0.0 8.0	11 †2	14 15	20 20	10 10	3.5 3.5	165,059 165,974	0 10	99.00	10.00		2.11	20.29 20.29				33 3.3	19	
Sun 7/6/97 13:30	414.00		11.0	0.U 5.C	6.0	6.0 6.0	8.0 8.0	6.0 6.0	16	10	20	10	3.6 3.6	166,179	0	99.90	10.00			20.28				3.3 3.3	15	r
Mon 7/7/97 7:00	431.50		2.0	6.0	6.0	9.0	9.0	9.8	13	16	20	10	2.0	166,761	ŏ				2.36	22.83				58		
Mon 7/7/97 13:00	437.50		0.0	5.5	5.0	9.0	0.0	7.8	12	16	20	10	2.0	187,059	10	99.83	10.00			22.63	18,040	542	184	58	19	
Tue 7/8/97 7:00	455.50		5.0	6.0	6.0	9.0	9.0	8.2	13	17	20	10	2.5	167,978	15				2.38	22.03				4.7	12	!
Tue 7/8/97 13:00	461.50		0.0	5.5	5.5	9.0	9.0	7.8	12	16	20	10	2.0	166,290	0	99.77	10.00			22.83				58		
Wed 7/9/97 7:00 Wed 7/9/97 13:00	479.50 485.50		0.0 0.0	7.0 6.0	6.5 6.0	10.0 10.0	10.0 10.0	0.2 7.0	13 12	18 18	20 20	10 10	2.0 2.0	169,185 169,484	0 15	99.74	10.25		2.64 2.64	25.36 25.38	19,400	444	152	5.8 5.6	12	2.43
Thu 7/10/97 7:00	503.50		0.0	7.0	0.0 0.5	11.0	11.0	8.4	12	17	20	10	2.0	170,422	15	00.74			2.91	27.90	10,100	777	194	50	12	
Thu 7/10/97 13:00	509.50		0.0	8.5	8.5	11.0	11.0	8.4	12	18	20	10	3.0	170,703	Ö	99.79	10.00			27.90				39	**	•
Fri 7/11/97 7:00	527.50	84	0.0	8.0	7.5	12.0	12.0	8.2	12	18	20	10	2.5	171,427	0		10.00	3.93	3.17	30.43				47		
Fri 7/11/97 13:00	533 50		0.0	7.0	0.5	8.0	6.0	8.4	11	18	20	10	3.0	171,748	15	89.81	10.00			20.29	18,900	412	158	3.9	12	2.36
Sat 7/12/97 7:00	551.50		0.0	8.0	7.5	8.0	8.0	8.0	11	15	20	10	3.0	172,941	15		10.00			20.29				3.9	t2	1
Sal 7/12/97 13:00	557.50		0.0	7.0	8.5	8.0	8.0	8.4	12	16	20	10	3.0	173,256	0	99.83				20.29				3.9		
Sun 7/13/97 7:00	575.50		0.0	0.0	6.5	8.0	8.0	0.2	11	15 17	20	10	3.0	174,417	15	00.82			2.11	20.29				3.9	(2	
Sun 7/13/97 13:30 Mon 7/14/97 7:00	582.00 599.50		0.0 0.0	8.5 9.5	8.0 9.0	8.0 8.0	0.0 0.0	0.4 7.8	12 13	16	20 20	10 10	3.0 3.5	174,706 175,910	0	99.63	10.00		2.11	20.29 20.29				3.9 3 3		
Mon 7/14/97 13:00			0.0	8.0	8.0	8.0	8.0	-8.6 	-11	-18	20	10	3.0	178.308	-16	09.94				20.28	18250	162		3.9		2.03

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APP-15

TABLE **B-3** Operating data Zeeweed phase II

		TT	ţ		outre	[pm]	F			. 6	ð	[3eC]	5	(Jac)	(jes	Ê			[udb]		(µ6ш)		8	ш,	2 2	DS/d
	Derating	E			Back	. 4	se [tpm]	ALL22	giard)	 Carringge Outlet (psig) 	Frequen		ā g	ar ca	Š	- PA			9 9 9		MLSS (n	(T) (mg/r)	17 CB(L OT	U U	
	0 10 10			actum Beto actourse (in	Actum After A Hg]	Backpr		e Pri			Ξ.	n D n	8	e to	Wasto	Ľ À	[sctm]		ette Par Backo		۲. A	CBOD	enito	Бе Д	etent	Siudge Production
	e (hrs)		<u>.</u>	E F F	(SH u	Treas Orte B	st Bar			actiques ressure	₩ N m	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	l i i i i i i i i i i i i i i i i i i i		8	Amen d	Ш.	P [psi]	E CO	Plue (Doctor)		20	ary M		욄	açi Q
Date & Time	<u> </u>		88	ا ف ح	لتشكر		13	a s		ا في قال	а П	ă		ل_ق_ا	ĝ.	LŁ	ليتجبأ	ليقيا	<u>i a</u>			ič	ξĔ	<u>£</u>	<u>Ŝ</u>	<u>ő</u>
Tue 7/15/97 7:00 Tue 7/15/97 13.00	623.50 629.50		0.0 0.0	9.0 6.0	8.0 6.0	6.0 6.0	0.0 8.0	6.6 - 6.2	13 12	18 16	20 20	10 (8	3.0 3.0	177,149 177,641	15 0	99.83		4.42		20.29 20.29				· 39 39		
Wed 7/16/97 7:00	647.50		0.0	8.5	6.0	8.0	8.0	8.6	13	18	20	10	3.0	178,379	Ō		10.50	4.17	2.11	20.29				39		
Wed 7/16/97 13:00	653.50	94 64	0.0 0.0	6.0 8.5	8.0 8.0	6.0 8.0	8.0 8.0	8.2 8.8	12 13	17 18	20 20	10 10	3.0 3.0	178,743 179,398	16 10	99.79			2.11 2.11	20.29	17,100	10	н	3.9 3.9	10	2.57
Thu 7/17/97 7:00 Thu 7/17/97 13:00	871.50 677.50		0.0	8.0	7.5	8.0 8.0	0.0 0.0	8.6	12	17	20	10	3.0	179,734	0	99.79	10.00			20.29				39		
Fili 7/18/97 7:00	695.50	83	0.0	9.0	8.0	8.0	8.0	0.8	13	18	20	10	3.0	180,374	0				2.11					3.9		
Fil 7/18/97 13:00 Sat 7/19/97 7:00	701.50 719.50	03 81	0.0 0.0	8.0 8.0	7.5 8.0	8.0 8.0	8.0 8.6	7.8 8.2	12 12	17 17	20 20	10 10	3.0 3.0	180,730 181,128	10 †8	99.79	10.00		2.11 2.11	20.29	16,400	16	16	3.9 3.9	10 10	2.46
8at 7/19/97 13:00	725.50		0.0	8.0	8.0	8.0	8,0	8.4	12	18	20	10	3.0	181,224	0	99.79			2.11	20.29				3.9		
Sun 7/20/97 7:00	743.50	82	0.0	0.0	8.0	8.0	8.0	7.8	12	17	20	10	3.0	181,249	18				2.11	20.29				3.9	10	
Sun 7/20/97 13:00 Mon 7/21/97 7:00	749.50 787.50	91 87	0.0 0.0	8.0 7.0	7.5 6.5	8.0 8.0	6.0 6.0	8.2 9.0	12 13	16 17	20 20	10 10	3.0 4.0	181,423 181,487	0	99.79	10.00		2.11 2.11					3.9 2 9		- 1
Mon 7/21/97 13:00	773.50	94	0.0	7.5	8.5	8.0	8.0	7.0	12	\$7	20	10	4.0	181,912	18	99.64				20.29	13,750			2.9	10	2 06
Tue 7/22/97 7:00	791 50 797.50	88 94	0.0 0.0	0.0	7.5 7.5	8.0 8.0	8.0 6.0	8.9 6.4	13 12	18 16	20 20	10 10	4.0 4.0	183.204 183.638	14 0	99.66	10.25	3.93	2.11 2.11	20.29 20.29				2.9 2.9	13	
Tue 7/22/97 13:00 Wed 7/23/97 7:00	815.50	85	0.0	7.5 8.5	8.0	80	8.0	8.8	13	18	20	10	4.0	184.371	ŏ	05.00			2.11	20.29				2.9		
Wed 7/23/97 13:00	821.50	94	0.0	8.0	7.0	8.0	8.0	8.8	12	18	20	10	4.0	184,782	14	99.68			2.11	20.29	14,400			29	13	1.66
Thu 7/24/97 7:00	839.50	85	0.0	8.0	7.0	8.0	8.0	9.0 8.8	12 12	17 15	20 20	10 10	4.0	185,406 185,470	14 0	99.76 99.68	9.50		2.11	20.29				2.9 2.9	13	
Thu 7/24/97 13:00 Fri 7/25/97 7:00	845.50 863.50	93 86	0.0 0.0	8.0 8.0	7.0 7.0	8.0 8.0	8,0 6,0	0.0 8.8	12	10	20	to	4.0 4.0	185,742	0	100.00				20.29				2.9		
Fri 7/25/97 13:00	069.50	85	0.0	7.6	8.5	8.0	8.0	8.4	12	18	20	10	3.5	166,116	14	99.87	10.00			20.29	14,449			3.3	13	1.69
Sat 7/28/07 7:00	897.50 893.60	89 95	0.0 0.0	6.5 7.0	6.0 6.5	8.0 8.0	相.0 8.0	6.9	13 12	18 18	20 20	10 10	4.0	166,622 166,997	07	99.87 99.94	10.25		2.11	20.29				2.9 2.9	26	l l
Sat 7/26/97 13:00 Sun 7/27/97 7:00	911.50	89 89	0.0	7.0	6.5	0.0 0.3	6.0 6.0	8.8	12	te	20	10	4.0 1.0	187,515	14	99.82			2.18					29	13	l
Sun 7/27/97 13:00	917.50	94	0.0	7.0	8.5	8.0	8.0	8.0	12	17	20	10	4.0	187,792	0	99.88	10.00	3,44	2.11	20.29				2.9		
Mon 7/28/97 7:00	935.50	88 94	0.0	8.5 8.0	8.0 7.5	10.0 10.0	10.0	8.9 8.4	14 12	19 17	20 20	10 10	4.0	168,237	14 0	99.88 99.88			2.64 2.64		15300			2.9 2.9	13	1.79
Mon 7/28/97 13:00 Tue 7/29/97 7:00	941.50 959.50	94 86	0.0 0.0	8.6	0.0	12.0	12.0	0.1 8.6	14	19	20	10	4.0 4.0	188,636 189,286	18	99.84			3.17	25.38				29	10	
Tue 7/29/97 13:00	965.50	-	0.0	10.5	9.5	12.0	12.0	6.0	12	17	20	10	4.0	189,592	Ø	89.84	10.00	5.16	3.17					29		
Wed 7/30/97 7:00	983 50 989.50	88 95	0.0 0.0	10.0 6.0	9.5 7.5	11.0 8.0	11.0 8.0	6.0 9.0	13 12	19 18	20 20	10 10	4.0 4.0	190,059 190,352	16 0	99.80 99.88	10.25		2.91	27.90	15300			29 2.9	12	2 04
Wed 7/30/97 13:00 Thu 7/31/97 7:00	1007.50	87	0.0	8.5	6.0	8.0	9.0	9.0	13	18	20	10	4.0	190,715	18	89.64			2.38					2.9	10	1
Thu 7/31/97 13:00	1013.50		0.0	8.5	8.0	8.0	6.0	9.8	12	16	20	10	4.0	191,033	0	99.84			2.11	20.29				2.9		
Fil 8/1/97 7:00 Fil 8/1/97 13:00	1031.50 1037.50	87 94	0.0 0.0	8.5 8.0	8.0 7.0	8.0 8.0	8.0 8.0	9.2 7.6	13 13	19 18	20 10	10 20	4.0	191,574 191,938	18	99.86 99.86	10.25		2.11	20.29	14700			2.9 2.9	12	1.96
Sat 8/2/97 7:00	1055.50	87	0.0	8.0	7.0	8.0	8.0	6.6	13	17	10	20	4.0	193,076	14	99.88			2.11	20.29				2.9	(3	
Sat 6/2/97 13:00	1061.50	91	0.0	8.0	7.0	8.0	8.0	8.6	12	17	10	20	4.0	193,441	0	99.68		3.93		20.29				29		
Bun 8/3/97 7:00 Sun 8/3/97 13:00	1079.50 1085.50	98 98	0.0	7.0 7.0	6.5 6.5	8.0 8.0	8.0 8.0	9.1 9.4	13 12	18 17	10 10	20 20	4.0 4.0	194,176 194,398	18 0	99.86 99.86		3.44 3.44		20.29				29 29	12	
Mon 8/4/97 7:00	1103.50		0.0	7.5	7.0	8.0	8.0	9.2	13	18	10	20	4.0	194,587	18	99.00	10.25			20.29	14150			2.9	12	1 89
Mon 6/4/97 13:00	1109.50		0.0	8.0	7.0	8.0	8.0	8.8	12	18	10	20	4.0	194,950	0	99.86	-	-	2.11	20.29				29		
Tue 8/5/97 7:00 Tue 8/5/97 13:00	1 127.50 (133.50	87 94	0.0 0.0	8.0 8.0	7.5 7.0	8.0 8.0	0.0 8.0	0.0 7.2	13 13	18 18	10 10	20 20	1.0 1.0	195,802 196,171	16 0	99.86 99.86			2.11	20.29 20.29				2.9 2.9	12	ļ
Wed 8/6/97 7:00	1151.50	87	0.0	0.5	8.0	8.0	8.0	7.8	14	10	10	20	2.6	197.148	14	99.85	10.00	4.17	2.11	20.29	12300			4.7	13	1.44
Wed 6/6/97 13:00	1157.50	96 68	0.0	6.0 9.0	7.5 8.5	6.0 B.0	8.0 8.0	7.4 8.0	12 14	17 19	10 10	20 20	.2.5 2.5	179,457 198,330	0 10	99.81 99.86			2.11	20.29				4.7 4.7	19	
Thu 8/7/97 7:00 Thu 8/7/97 13:00	1181.50		0.0	8.Q	6.a 7.5	8.0	0.V 8.0	7.4	12	18	10	20	2.5	198,628	0	99.66			2.11					4.7	10	- (
Fri 8/8/97 7:00	1109.50	88	0.0	9.0	8.5	8.0	8.0	0. 0	14	20	10	20	2.5	199,510	10	99,86	10.25	4.42	2.11	20.29	12850			4.7	18	1.10
Fri 8/8/97 13:00	1205.50		0.0	9.0 8 c	7.5 8.0	8.0 8.0	8.0 6.0	7.6 8.0	13 14	18 20	10 10	20 20	2.5 2.5	199,809 200,676	0 10	99.98 99.98	10.00		2.11 2.11	20.29				4.7	10	J
Sal 8/9/97 7:00 Sat 8/9/97 13:00	1223.50 1229.50		0.0 0.0	8.5 8.5	8.U 6.0	8.0	8.0	0.0 7.9	13	16	10	20	2.5	200,975	0					20.29				4.7	10	

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APP-16

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TABLE D-3 OPERATING DATA ZEEWEED - PHASE II

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Date & Time	Currutative Operating Time [ins]	Tenperature (*F)	Sprayer Purrus Pressure Ipsi	Vacuum Betore Badputse [in Hg]	Vacum Atter Backpuble [in Hg]	Permata Rata Betore Bacigoutse (tom)	Permeane Rame After Backputse (Ipm)	Badqutse Pressure [psig]	Badquise Cartridge Pressure intet (psig)	Bactouise Carredge Pressure Outlet (psig)	Bacipuise Frequency [min]	Badquitse Duration (sec)	Permeate Rate to Drain [tbn]	Perneate Totalizer (gal)	Siunge Waste Voi (gal)	Avs. Daily Recovery (%)	Air Flow [sctm]	TMP (psi)	Perneate Ratte Betine Baciquise (gpm)	Fiur [gp4/ft [*]]	Bioteactor MLSS [mg/]	Feet CBOD (mg/L)	WMTP Intiuent CBOD (ጠይሲ)	Hytraulic Retention Time	Solds Petermon Time (d	Siutge Production (Ibs/d
Sun 8/10/97 7:00	1247 50	65	0.0	9.0	8.5	0.0	8.0	7.8	14	20	10	20	2.5	201,846	10	89.86	10.25	4.42		20.29	12850			47	19	1 07
Sun 8/10/97 13:00	1253 50	95	0.0	8.5	8.0	0.0	8.0	7.6	13	19	10	20	2.5	202,142	0	99.66				20 29				47		
Mon 8/11/97 7:00	1271.50	67	0.0	9.0	8.5	8.0	0.0	8.0	- 14	20	10	20	2.5	203,021	11	9 9 85				20.29	14400			4.7	17	1 32
Mon 8/11/97 13:00	1277.50	85	0.0	0.0	8.0	8.0	8.0	7.4	13	19	10	20	2.5	203,316	0	99 85	10.00	4.42	2.11	20.29				47		
Tue B/12/97 7:00	1295.50	87	0.0	9.0	8.5	8.0	8.0	7.8	14	20	10	20	2.5	204,188	10	99.66	10.25	4.42	2.11	20.29				47	19	1
Tue 8/12/97 13:00	1301 50	95	0.0	0.5	8.0	8.0	8.0	7.4	13	19	10	20	2.5	204,483	Q	99.86	10.00	4.17	2.11	20.20				47		
Wed 6/13/97 7:00	1319.50	85	0.0	9.5	9.0	8.0	0.0	7.9	14	20	10	20	2.5	205,358	11	99.85	10.00	4.67	2.11	20.29	13700			47	17	1 26
Wed 8/13/97 13.00	1325 50	94	0.0	9.5	9.0	0.0	8.0	7.2	13	19	10	20	2.5	205,842	0	9 9.65	10.00	4.67	2.11	20.29				47		
Thu 8/14/97 7:00	1343.50	84	0.0	10.0	9.5	8.0	0.0	.7.4	15	21	10	20	2.5	208,529	10	99.86	10.00	4.91	2.11	20.29				47	19	1
1hu 8/14/97 13:00	1349.50	95	0.0	9 .5	9.0	8.0	8.0	7.7	13	19	10	20	2.5	206,810	0	99.86	10.00	4.67	2.11	20.29				4.7		
Fil 8/15/97 7:00	1367.50	85	0.0	10.5	9.5	8.0	8.0	7.8	- 14	21	10	20	2.5	207,690	10	99.86	10.25	5.16	2.11	20.29	13100			47	19	1 09
Fri 8/15/97 13:00	1373.50	96	0.0	9.5	9.0	8.0	8.0	7.2	13	10	10	20	2.5	207,971	0	99.86	10.00	4.67	2.11	20.29				4.7		

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TABLE B-4 WATER QUALITY DATA MEMCOR - PHASES I AND II

						Feed	Water								-					·		Мел	1cor Fl	itrato													
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		Ą					-	-	£_	Ē	Ē					_												[və		horus					_		
Date Max 14 04	TDS [mg/l]	Conductivi [uS/cm]	Ha	Turbidity	TSS [mg/]	TOC [mg/l]	Color Color unite		Total Colifo [CFU/100ml]	Fecal Colitor [CFU/100mi]	HPC [CFU/ml]	Run Time	Conductivity A.M. (uS/cm)	Conductivity P.M. [uS/cm]	Conductivity AVG [uS/cm]		furbidity A.M. (NTU)	furbidity 2.M. (NTU)	rurbidity VVG (NTU)	rss ma/i	ī	(V@m] 00.	tolor color unite)	YV P	[l/6m] SQ	00 , [mg/]	[//ɓɯ] N-『H	-NO ₃ -NO ₂ {mg/l	(Ngm] N	Total Phosp Ia/I	rotal Coliform CFU/100mij	cal Coliform FU/100ml]	tPC [CFU/m(]	ConductIvity [uS/cm]	rbidity [NTU]	[Jgm] SQJ	S [mg/]
Mon 14-04 Tue 15-04	1120	1570		1.80								91.5	1680	1630		7.09			0.09	<u> </u>		<u> </u>	_0.2	<u> </u>	<u>E</u>	Ô	<u>Z</u>	<u>Ż</u>	Ē_	<u> </u>	<u> </u>	ê Ö	<u><u> </u></u>	82			TSS
Wed 16-04		1620	7.05	3.70					7	5	1400	111.4 137.3					0.06			0.4	0.67			0.119	•									1600 7.	18.0 28 21.0		44
Thu 17-04 Fri 18-04				2.60 3.12		8.2	2.5	0.117	7			160.3	1780	1800	1790	7.00	0.11	0.12	0.12		0.45 0.73	7.8		0.138							ND	ND	2100		27.0	0	
Sat 19-04		2020	7.18	2.50								183.3 203.9		1630 2160		7.16	0.16	0.15 0.20			1.47													1820 7. 7.	14 27.0 28 18.0		
Sun 20-04 Mon 21-04				2.80 3.00								226.2	2260	2320	2290	7.24	0.15	0.15																	14.6	6	
Tue 22-04		2220	7.19	3.20								249.9 274.2	2240 2250	2460 2380		7.16	0.14	0.14	0.14		1.87														18.0 26.0		
Wed 23-04 Thu 24-04				3.10 3.90		NS	NC	0 100				296.9	2270	2400	2335	7.09	0.12	0.22	0.24 0.17	0.2	0.93 0.73			0.121										2220 7.	22 21.0)	28
Fri 25-04		2080	7.11	3.10		143	NS	0.123)			319.7 325.2	1990	2130	2060	7.09	0.22	0.83	0.53		1.27	7.6	5	0.119										1990 7.	33.0 33 21.0		
Sat 26-04 Sun 27-04			7.15	3.20 14.70	1							346.2	2020	2010					0.22																		
Mon 28-04		1790	7.16	3.10								370.0 392.9	1930 1830	1950 1970			0.24		0.38																24.0 28.0		
Tue 29-04 Wed 30-04	1285		7.41 7.22	3.20	4				3	2	576	416.9	1990	1970	1980	7.34	0.06 0.06	0.04	0.06	1.0	2.93 1.33			0 117	1288										17.0)	
Thu 1-05			7.11			8.4	23	0.147				443.1 466.2		2110	2090	7.18	0.12	0.07	0.10		1.80			0.117	1200						ND	ND	264	1960 7.	46 15.8 27.0		5 24
Frl 2-05 Sat 3-05			7.12 7.23									489.2	2110	2100	2105	7.17	0.10	0.07	0.14 0.09		2.20 1.13	8.1	17	0.139										2020 7.	28 25.0)	
Sun 4-05				2.30								512.1 534.9	2100	2090	2095	7.21	0.11	0.06	0.09																17.0 12.2		
Mon 5-05 Tue 6-05			6.99	2.30 1.60	0.0							558.9	2020	2000	2010	7.11	0.18	0.17 0.04	0.18 0.04		1.80														5.8		
Wed 7-05			7.09		2.8						[586.9	2020	2070	2045	7.14	0.06	0.03	0.05	0.4	1.93			0.133										2040 7.	9.6 25 12 7		22
Thu 8-05 Fri 9-05			7.04	1.40 2.00		NS	NS	0.111				605.9 628.9	2060	2120 2290	2110	7.13	0.17	0.20 0.11	0.19 0.10		1.20 0.40	7.6	10	0.106										2060	16.6		~
Sat 10-05			7.07									651.2	2030	2020	2025	7.02	0.03	0.03	0.03		1.20		.0	0.100										2060 7.	23 8.3 10.0		J
Sun 11-05 Mon 12-05			7.00									675.5 697.6	2270	2260	2265	7.10	0.36	0.08	0.20 0.22																9.3		ļ
Tue 13-05	1407	2220 2150	۵.9 7.17	3.60 1.60	2.0				31	50	16 100	721.4	2230	2070	2150	6.96	0.12	0.10			1.53														8.6 13.0		1
Wed 14-05 Thu 15-05		2230	6.98	2.10						50	16,100		2220	2250	2235	7.17	0.13	0.11	0.12	0.2	1.60																1
Fri 16-05		2480 2300				NS	NS	0.106					2440	2380	2410	7.06	0.12	0.17	0.15	~-	1.93			0.101	1411									2330 7.	7.5	1431	7.0
Sat 17-05		2220	6.99	2.30								797.6 820.9		2300 2330	2290 2310	6.98 7 01	0.07	0.10 0.12	0.09		0.80													2000 7.	6.8		1
Sun 18-05 Mon 19-05		2220 2190	6.89 7.09	4.50					ND	16		843.4	2220	2250	2235	7.03	0.15	0.09	0.12														Ì		6.0		5
Tue 20-05		2160	6.9	1.50	3.6	NS	NS	0.108		16 21	3,700 5,000	889.6	2200 2150	2270 2170	2235 2160	7.13 6.95	0.05	0.03 0.07	0.04 0.07	0.4	2.67 2.27		۲.	0 400											6.2 6.0		
Wed 21-05 Thu 22-05		2310 2260									1	912,7	2320	2370	2345	7.01	0.10	0.18	0.14	U.4	2.27 4.53			0.106										2140 7.			10.0
Fri 23-05		2200	7.01	1.29								935.8 958.9	2260 2240	2260 2440	2260 2340	6.97 7.06	0.11	0.21 0.20			1.93 1.27	7.0	5											2260 7.	7.8 11 7.7		
Sat 24-05 Sun 25-05		2300 2240										982.8	2340	2420	2380	7.10	0.09	0.20			1.21														5.2		
Mon 26-05		2020	7.10	1.40								1003.4 1026.7	2290 2070	2240 2100	2265 2085	7.04	0.09	0.14			1 70														6.0 7.1		
Tue 27-05 Wed 28-05		1860 2010			4.0				25 ND	31	2,900	1051.6	1860	1990	1925	7.13	0.04		0.05 0.05		1.73 1.20				1167						NS	NS	2000	1900 -	25.0		
Thu 29-05		1880	6.97	1.60		6.9	5	0.110		35	3,100	1074.7 1097.6	2110	2100	2105	8.00	0.06		0.06		3.93											110	2600	1860 7.3	0 6.4 9.3		4 10.0
Fri 30-05 Sat 31-05		2000 1830									1.	1119.1	2040	1990	2015	7.01	0.03	0.04 0.03	0.03		2.53 2.93			0.108										1850 7.2	2 11.0		
Sun 1-06		1820	7.08	26.00							1.	1140.7 1163.2	1840	1860	1850	7.07	0.16	80.0	0.12																10.1 8.9		
Mon 2-06 Tue 3-06		1780 1750			2 80						Ι.	1187.9	1810	1980	1895	7.06	0.06	0.03	0.05		4.14														6.0		i I
Wed 4-06		1940			4.00						11	1210.0 1233.2	1840	2040	1940	7.06	0.09	0.06	0.08		7.50		,	0.102										1800 7.1	6.4 1 8.8		14.5
													1000	2000	1992	7.01	0.08	0.12	<u>0.10</u>		4.20												İ		6.6		

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TABLE B-4 WATER QUALITY DATA MEMCOR - PHASES I AND II

		Feed Water	Memcor Filtrate	
				Memcor Backwash
Date Thu 5-06 Fri 6-06 Sat 7-06	5 1700 6.87 1.74	[mg/] 54 TOC [mg/] 58 [color units] 70 [color units] Total Coliform [CFU/100mi] [CFU/100mi]	15283 1230 12.00 10.01 10.00	Conductivity [uS/cm] 18 10 10 10 10 10 10 10 10 10 10 10 10 10
Sun 8-06 Mon 9-06 Tue 10-06 Wed 11-06 Thu 12-06 Fri 13-06 Sat 14-06 Sun 15-06 Mon 16-05	1700 7.02 1.90 1520 6.93 1.10 984 1570 7.16 1.20 0.1 1640 7.00 1.94 1580 7.00 1.54 1630 7.11 1.22 1600 7.17 3.40 1620 7.10 2.12 1.20 1.20	.	1301.8 1620 1620 7.05 0.24 0.33 0.29 1325.4 1740 1740 1740 7.03 0.16 0.16 0.16 1325.4 1540 1660 1600 6.95 0.06 0.05 0.06 5.00 1369.8 1610 N/A 1610 7.14 0.10 N/A 0.10 0.2 5.20 977 1394.4 1680 1950 1815 7.00 0.14 0.19 0.17 4.00 977 1413.1 1740 N/A 1740 7.01 0.34 N/A 0.34 1434.1 1670 1710 1690 7.20 0.26 0.28 0.27 3.67 1458.1 1610 1600 1605 7.19 0.09 0.24 0.17 1480.1 1630 1620 1625 7.16 0.14 0.14 0.14	12.0 6.2 7.0 7.08 4.5 1570 7.23 6.8 989 9 7.21 8.2 1730 7.20 4.8 7.18 5.5 6.3
Tue 17-06 Wed 18-06 Thu 19-06 Fri 20-06 Sat 21-06 Sun 22-06 Mon 23-06 Tue 24-06 Wed 25-06 Thu 26-06	1.35 1.70 1.50 4.5 1.80 2.00 0.93 1.5 1.00 1.10		1528.4 NS NS NS NS NS NS NS 1551.4 1820 1830 1825 7.03 0.10 0.06 0.08 2.13 1574.9 1510 1500 1505 7.06 0.08 0.09 1.73 1598.4 1610 1590 1600 7.13 0.09 0.10 0.2 1.73 1598.4 1610 1590 1600 7.13 0.09 0.10 0.2 1.73 1521.4 1620 1600 1610 7.10 0.11 0.11 0.2 1.73 1528.4 1610 1560 7.14 0.14 0.12 0.13 1645.1 1560 1560 7.14 0.14 0.12 0.13 1665.9 1500 1600 1550 7.21 0.07 0.04 0.06 0.5 2.13 1687.5 1600 NS 1600 7.11 0.08 NS 0.08 2.13 1711.4 1460 1500 1490 0.05 0.05 0.05<	6.0 7.48 8.2 NS NS 7.16 5.3 7.13 5.7 7.28 6.2 9 7.36 4.3 5.
Fri 27-06 Sat 28-06 Sun 29-05 Mon 30-06 Tue 1-07 Wed 2-07 Thu 3-07 Fri 4-07 Sat 5-07	1.30 1.70 1.50 0.90 0.86 1.20 1.20 1.20 1.10 1.30 1.20	6 12 25 14,0	1733.0 1660 1700 1680 7.05 0.03 0.04 0.04 1.67 1755.1 1530 1770 1650 7.05 0.06 0.06 2.20 1779.3 1510 1760 1635 6.93 0.05 0.03 0.04 1802.9 1600 1660 1630 7.14 0.08 0.08 1826.8 1826.8 1610 1610 7.14 0.03 0.04 0.6 2.20 1849.2 1580 1610 1595 7.08 0.03 0.04 0.6 2.20 1849.2 1580 1610 1595 7.08 0.03 0.04 0.6 2.20 0.83 0.04 2.71 3.2 0.17 ND ND 12,000 1872.5 1650 1570 1610 6.99 0.04 0.03 0.04 2.20 0.109 1895.4 1650 1720 1685 6.95 0.04 0.03 0.04 1.93 1918.8 1690 1700 1695 6.90 0.03 <td>7.11 6.3 7.29 4.6 4. 7.15 8.1</td>	7.11 6.3 7.29 4.6 4. 7.15 8.1
Sun 6-07 Mon 7-07 Tue 8-07 Wed 9-07 Thu 10-07 Fri 11-07 Sat 12-07 Sun 13-07 Mon 14-07	1.30 1.60 2.86 1.00 1.20 1.50 1.65 1.30 1.50		1943.6 1650 1610 1630 6.93 0.05 0.04 0.05 1968.0 1670 1640 1655 6.99 0.04 0.05 0.05 1988.2 1590 1590 1590 7.05 0.05 0.02 0.04 0.4 1.87 5.3 10 0.103 0.36 1 ND 4,000 2011.5 1550 1670 1610 7.12 0.03 0.03 1.67 2034.8 1650 1720 1685 7.05 0.03 0.02 0.03 1.20 0.116 2057.7 1600 1680 1645 7.03 0.05 0.04 1.40 2081.2 1600 1860 1730 6.99 0.03 0.04 1.80 2104.4 1630 1720 1675 7.06 0.03 0.04 1.80 2104.4 1630 1720 1675 7.06 0.03 0.04 0.04	7.25 6.2 11. 7.24 6.5
Tue 15-07 Wed 16-07 Thu 17-07 Fri 18-07 Sat 19-07 Sun 20-07 Mon 21-07 Tue 22-07	1.90 1.2 1.60 1.36 1.10 (1) (2) (1) (2) (1) (2) (2) 1 (2) 1 (2)		2151.0 1600 1610 1605 7.08 0.04 0.03 0.04 1.47 6.7 5 ##### 995 0.43 0.06 3.46 1.9 0.05 15 ND 500 2174.2 1600 1700 1650 7.00 0.02 0.03 0.03 1.73 2197.4 1560 1680 1620 7.13 0.03 0.03 1.53 ##### 218.5 1600 (1) 1600 7.10 0.02 (2) 1510 1670 1590 6.98 (1) (1) 2.27 1263.4 1590 1650 1620 7.16 (1) (1) 2.27 1287.4 1480 1580 1530 7.11 (1) (1) 2.27 1287.4 1480 1580 1530 7.11 (1) (1) 2.27 1287.4 1480 1580 1530 7.11 (1) (1) 2.27 1309.9 1540 1510 1525 7.15 (2) 0.0 0.0 0.0	7.29 7.6 11. 7.20 9.4
Wed 23-07 Thu 24-07 Frl 25-07 Sat 26-07	(2) (2) (2) (2) (2)		333.1 1570 1550 1560 6.99 (2) 2.07 1480 1540 1510 7.13 (2) 2.07 0.131 379.8 1630 1510 1570 6.98 (2) 1.87 , 402.6 1520 1510 1515 7.08 (2) 1.2 1.2	7.22 8 7.21

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TABLE B-4 WATER QUALITY DATA MEMCOR - PHASES I AND II

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					F96	d Wate	r															Метс	or Filtra	ate		····		_	· · · · · ·	_				N	lemcor B	aciwasi	
	TDS [mg/l]	Conaucityiny [uS/cm]	pH Turbldity	(INTU) TSS	(ing/i) TOC fma/il	Color	[color units]	Total Coliform	[CFU/100ml]	Fecal Coliform [CFU/100ml]	HPC [CFU/mi]	Run Time	Conductivity A.M. [uS/cm]	ConductIvity P.M. [uS/cm]	Conductivity AVG [uS/cm]	Н	rurbidity A.M. [NTU]	rurbidity 2.M. [NTU]	Furbidity AVG (NTU)	[SS mg/]	IQ	roc [mg/l]	Calor color units]	МА	[//ɓw] SQ	lODs [mg/l]	(hgm] N- _t H	-NO ₂ -NO ₂ [mg/l]	KN [mg/]	-Total Phosphorus ng/ij	otal Coliform CFU/100mij	ecal Coliform CFU/100ml]	Pc [cFu/m]]	onductivity uS/cm]	4 urbidity [NTU]		
Sun 27-07			(2	2)				-		-		2448.7		1530	1525	7.06	(2)			<u> </u>		E	<u> </u>			<u>a</u>	_ <u>Z</u>	<u>z</u>	<u> </u>	<u>a -</u>	<u> </u>	<u> </u>	<u> </u>	02		_ <u> Ĕ</u> .,	Ĕ
Mon 28-07 Tue 29-07 Wed 30-07			(2 (2 (2	2) 5 2) 2)				·	16	10	19,900	2472.2 2495.2 2518.5	1530	1510	1430 1520	7.20 7.04	(2) (2)			0.2	0.8 1.07	7.6	15	0.104			0.04	0.7	1.1	0.6	ND	ND	5,600		7.31		2
Thu 31-07 Fri 1-08			(2	2)								2541.8	1540	1580			(2) (2)				1.07 1.2			0.124											7.19		
Sat 2-08			(2 (2 (2 (2 (2 (2) (2) (2) (2) (2) (2) (2) 2)								2564.9 2586.2		1710		7.04 6.96	(2) (2)				2.47																
Sun 3-08 Mon 4-08			(2	<u>2)</u>								2609.3	1540		1550	7.00								0.124													
Tue 5-08			(2	2) 2 2)								2632.8		1500 1500			(2) (2)		-1.00	0.17	2.47 0.87	6.4		0.105		1.08	0.02	3.9	1.0	0.8				7	7.22		:
Wed 6-08 Thu 7-08			(2 1.	2)								2679.3	1500	1670	1585	6.9 8	(2)		-1.00		1.8			0.137										-	7.21		
Fri 8-08			2.									2702.4		1550 1710	1540 1620		0.04		0.11 0.07		2.07																
Sat 9-08			1.5	56								2748.4							0.07		2																
Sun 10-08 Mon 11-08			1.4 1.8									2771.9	1500	1740	1620	7.05	0.2		0.25																		
Tue 12-08			1.6	39				7	1D	59		2795.1		1490 1660	1455 1565		0.08 0.04		0.03 0.03		1.73	7.6	5	0.11		0.61	0.03	2.8	2.3	1.77	ND	ND	1,500	7	7.16 15.4	5	:
Wed 13-08			3.7	75								2841.6		1530	1490				0.05		1.87 1.73			0.135										-		F	
Thu 14-08 Fri 15-08			2.1 2.4	19 13								2864.7	1490 1510	1610		7.2 7.1		0.01	0.04 0.03		1.67													'	.29 29.1	3	

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(1) - Unit Down for Cleaning (2) - Turbidimeter not working property NS - Not Sampled ND - Not Detected

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TABLE B-5 WATER QUALITY DATA ZEEWEED - PHASE I

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	1					Feed V	Vater												Zeew	eed Per	meate											7~-	weed (Concer	trate		
-	[-								266	Weed (Soncen	mate		
										_	_																										
Date	TDS [ma/l]	Conductivity Lus/cm1	Hd	Turbidity [NTU]	T\$\$ [ma/1]	TOC [mg/l]	Color	[color units]	UVA	Total Coliform [CFU/100ml]	Fecal Collforn ICFU/100ml1	HPC [CFU/mi]	Run Time [hr]	TDS [mg/l]	Conductivity A.M. [uS/cm]	Conductivity P.M. [uS/cm]	Conductlvity AVG [uS/cm]	Hd	Furbidity A.M. [NTU]	Turbidity P.M. [NTU]	Turbidity AVG [NTU]	TSS [mg/l]	SDI [CFU/ml]	roc [mg/l]	Color [color units]	AVU	[otal Coliform [CFU/100ml]	Fecal Coliform (CFU/100ml)	HPC [CFU/ml]	[DS mg/]	Conductivity uS/cm]	Ŧ	rurbidity NTU]	[SS mg/]	[otal Coliform CFU/100ml]	Fecal Coliform [CFU/100ml]	(PC [CFU/ml]
Mon 14-04		161(5.0		1670	1650		8.12		0.04	0.06											8.09					<u></u>
Tue 15-04 Wed 16-04 Thu 17-04 Fri 18-04		1620 1760 1580) 7.05) 7.01) 7.16	3.70 2.60 3.12	8.0	8.2	2 2	2.5	0.117	7	5	1400	29.0 53.0 75.3 101.0	.1101	1600 1660 1770 1570	1670 1690 1810 1580	1635 1675 1790 1575	8.08 8.05	0.06 0.08	0.10	0.06 0.06 0.09 0.14	0.33	0.47 1.07 0.13 2.80	7.7	0.00	0.125 0.117	16	15	3,500	1132	1610 1820		31 22	48			
Sat 19-04 Sun 20-04 Mon 21-04 Tue 22-04		225(222(222(7.19	2.80 3.00 3.20	4.4								124.0 148.0 173.0 197.0		2040 2260 2220 2240	2140 2310 2490 2440	2090 2285 2355	8.08 8.15 8.18	0.17 0.14 0.14	0.16 0.16	0.17 0.15 0.16 0.21	0.4	2.27 1.53			0.122				NS	2250	8.02 8.08 8.18 8.03	26	40			
Wed 23-04 Thu 24-04 Fri 25-04 Sat 26-04	4 4 4	2000 2080 2000) 7.16) 7.11) 7.15	3.10 3.20		NS	5 T	NS	0.123				221.0 245.5 270.0 292.0		2280 1970 2090 2010	2470 2170 2070 2020	2375 2070 2080	8.16 8.13 8.07	0.20 0.19 0.15	0.21	0.21 0.23 0.18 0.21		1.20 0.67 0.47	7.4	7	0.122						8.08 8.10 8.06 8.12	21	-0			
Sun 27-04 Mon 28-04 Tue 29-04 Wed 30-04	 128: 	5 1970 2000) 7.16) 7.41) 7.22	2.40	4.0					3	32	576	389.5	1270	1940 1840 2000 2070	1950 1980 1950 2160	1975	8.07 8.03	0.05 0.06	0.04 0.04	0.53 0.05 0.05 0.21	1.0	2.33 0.73 1.13			0.119	1	14	408	1266	1960	8.21 8.05 8.03 8.19	22	32			
Thu 1-05 Fri 2-05 Sat 3-05 Sun 4-05		2130 2090 2010) 7.23) 7.07	2.10 2.30 2.20		8.4		23 (0.147				413.5 437.0 459.0 484.0		2030 2210 2100 1970	2180 2140 2100 1960	2175	8.36 8.20	0.06 0.06	0.04 0.06	0.09 0.05 0.06 0.12		2.33 1.93	8.1	10	0.142					2030	8.11 8.39 8.11 7.87	17.3				
Mon 5-05 Tue 6-05 Wed 7-05 Thu 8-05		2100 2080	7.11 7.09 7.04	1.60 2.60 1.40	2.80)		l	0.111				509.0 533.0 557.5 581.5	1349	1980 2030 2090 2060	2220 2100 2130 2360	2110 2210	8.11 8.12 8.10	0.06 0.11 0.07	0.04 0.08 0.08	0.04 0.05 0.10 0.08	0.2	2.53 2.07 1.20 0.53	7.5		0.135 0.110					1990	8.04 8.02 8.17 8.10		20			
Fri 9-05 Sat 10-05 Sun 11-05 Mon 12-05		2500 2230 2220	7.00 7.00	4.70 11.20 3.60									604.5 629.5 653.0 677.0		2430 2200 2140	2230	2245 2190 2185	8.31 8.32 8.09	0.39 0.94 0.08	0.25 0.20	0.06 0.32 0.57 0.07		2.53 0.93	•								8.04 8.28 8.28 8.10					
Tue 13-05 Wed 14-05 Thu 15-05 Fri 16-05 Sat 17-05		2230 2480 2300	6.98 7.03 6.97	2.10 1.30 1.30	2.00)			0.106	31	. 50	16,100	701.0 724.8 750.5 772.5	1410	2140 2440 2320	2250 2610 2340	2170 2195 2525 2330	8.12 8.09 8.09	0.16 0.07 0.08	0.08 0.15 0.30	0.19	0.2	1.53 1.53 0.93 3.33			0.108	6	3	13,000	1426	2170 2460	8.07	NS	42.8			
Sun 18-05 Mon 19-05 Tue 20-05 Wed 21-05		2220 2190 2160	6.89 7.09 6.90	2.30 4.50 1.03 1.50 2.60	3.6			ŧ	0.108	ND ND	16 21	3,700 5,000	868.5		2200 2220 2140	2150 2370 2190	2175 2295 2165	8.18 8.33 8.06	0.05 0.04 0.08	0.04 0.06	0.07 0.04 0.07	0.2	2.13 2.67			0.112	2 11	1 44	1,200 2,500		2120	8.07 8.00 8.38 8.01	17.8	20.0	ND ND	ND 111	25,000 5,600
Thu 22-05 Fri 23-05 Sat 24-05 Sun 25-05		2260 2200 2 30 0	6.94 7.01 7.04	1.25 1.29 1.30 2.10									893.5 916.5 942.0 964.5		2350 2270 2320	2270 2480 2400	2375 2360	8.03 8.26 8.30	0.06 0.05 0.09	0.09 0.07 0.11 0.12	0.07 0.08 0.11		2.33 2.07 0.60	7.1	5						2330	8.06 8.03 8.26 8.11	35 .0				
Mon 26-05 Tue 27-05 Wed 28-05 Thu 29-05	1159	2020 1860 2010	7.10	1.40 3.70 1.90	4.0			,	0.110	25 ND	31 35		988.5 1013.0 1036.5 1061.5 1084.5	1188	2020 1880 2020	2080	2075 1960	7.15 8.25 7.02	0.06 0.05 0.05	0.11 0.04 0.06	0.09 0.05 0.06	1.0	2.67 2.40 5.13'			0.110	12 ND	5 ND	400 1500		1880	8.00 7.21 8.18 8.04 8.00		52	ND	114	2900

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TABLE B-5 WATER QUALITY DATA ZEEWEED - PHASE I

					Fe	eed Wa	iter			-		· · · · · ·					_					_													
										<u> </u>			······			··		Zeev	veed Pe	ermeate									<u> </u>		7				
																													+		Zeewee	Conce	entrate		
Date	TDS [mg/]	ConductIvIty [uS/cm]	Hd	Turbidity [NTU]	TSS [mg/l]	TOC [mg/l]	Color [color units]	AVL	Total Coliform [CFU/100mf]	^r ecal Coliform CFU/100mij	PC [CFU/m]]	lun Time [hr]	SC SC	onductivity .M. [uS/cm]	onductlvity .M. [uS/cm]	onductivity VG [uS/cm]	- -	ırbidity M. [NTU]	irbidity M. [NTU]	ırbidity /G [NTU]	SS Mg/l	H FU/ml]	OC [mg/l]	olor ofor units]		fot a t Coliform CFU/100mi]	Fecal Coliform (CFU/100ml)	c [cFu/m]]		(cm]	bidity U	. 5	Total Coliform [CFU/100ml]	Fecal Coliform [CFU/100ml]	[CFU/m]]
Fri 30-05		2000	7.00	1.35			<u> </u>	<u> </u>					<u> </u>	<u>0 4</u>	<u> </u>	<u> </u>		_ <u>F <</u>	F d		<u></u>	SDI [CFI	2	88	<u> </u>	ēυ	19 C	ă		NS Ha	Turbio	SS Jo	> 월드	E G	ő
Sat 31-05		1830	7.00									1108.5 1132.5		2140	2030	2085	8.05	0.04	0.04	0.04		3.60					<u></u>					<u> </u>	<u>, F 2</u>	<u><u> </u></u>	Ī
Sun 1-06				26.00								1156.5		1880	1810	1845	8.00	0.15	0.06	0.11										8.1 8.0					
Mon 2-06			7.02									1180.5		1880 1870	1860	1870	8.30	0.62	0.14	0.38										8.1					
Tue 3-06		1750		1.20	2.88							1205.5		1760	2020		7.97	0.06	0.05	0.06		2.80								8.0	3				
Wed 4-06			6.91									1228.5		2000	1990	1970	8.01	0.04	0.04	0.04	1.0	2.60							186		4 20.0	40			
Thu 5-06								0.115				1252.5		1730			7.99	0.09	0.12	0.11		4.80								7.9		40			
Fri 6-06											-	1276.5		1710	1740	1725			0.11	0.11		4.20	6.7	10	0.117				170		4 26.0				
Sat 7-06				1.60								1300.5		1610				0.06	0.10 0.05	0.08		7.20								7.94					
Sun 8-06												1324.5		1720	1740		3.04	0.12	0.05	0.11 0.11										8.08					
Mon 9-06 Tue 10-06	984	1520 1570	0.83	1.10	<u>.</u>							1349.0		1550		1625	3.08	0.07	0.08	0.08		7.10								8.00					
Wed 11-06	304		7.16 7.00	1.20	0.8							1373.0	975	1620	1820	1720	3.09	0.07	0.05	0.06	0	3.75								8.13					
Thu 12-06												1397.0		1680	2000	1840	3.13	0.17	0.33	0.25	~	8.10							978 159		3 17.0	36			
Fri 13-06			7.11									1420.5		1730	N/A	1730	7.74	0.34	N/A	0.34		0.10								8.22					
Sat 14-06		1600	7.17	3.40								1445.0		1660	1720	1690	3.02	0.32	0.10	0.21		5.67							160		2 18.6				
Sun 15-06		1620										1469.0		1620	1600	1610	8.24	0.18		0.14										8.06					
Notes:						<u> </u>						1493.0		1640	1630	1635	8.13	0.22	0.14	0.18										8.42	2				
NS - Not Samp	led										l				_										· · · · · · · · · · · · · · · · · · ·					8.40	/				

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		(m)												역			Ē																					T				0.010104		,
16-06	TDS [mg/l]	S Conductivity [uS/	<u>H</u> 7.38	TSS [mg/]	V\$S [mg/]	DO [mg/]	BODs [mg/]	CBOD [mg/]	COD [mg/l]	TOC [mg/l]	[Vgm] N-tHN	[v6m] ^c ON- ^c ON-N	tkN [mg/J]	P-Total Phosphori [mg/]	Run Time [hr]	TDS [mg/]	Conductivity [uS/c	H <u>1</u> 8.45	o Turbidity & A.M. [NTU]	<u> </u>	_ F ∢	155	[/ ⁶ m] Od	BOD, [mg/l]	CBOD [mg/]	COD [mg/J]	[h@m] N-tHN	N-NO ₁ -NO ₂ [mg/l]	TKN [mg/l]	P-Total Phosphorus [mg/]	TOC [mg/l]	Color (color units)	sol	AVA	Total Coliform [CFU/100ml]	Facel Colifornia (CFU/100ml)	HPC [CFU/m]	[DS [mg/]	Conductivity [uS/cm]	H	"urbidity (NTV)	ML)SS {mg/]	ML)VSS [mg/l]	(fmod)
7-06 8-06																	1000	0.43	0.09	N/A	0.09																		1.530	8.40	9.80		<u> </u>	
9-06 9-06		1420 1560		507	367	0.5 0.5	264	A E 4	-						6.0			7.39	0.13	0.12	0.13		1.60										3.07											
1-06		1610	6.90	307	307	0.4	204	251 7	70		20.1	0.58	28.8	4.76	30.0 54.0			7.42 7.38	0.10	0.09	0.10		1.40	1.51	1.63	4.0	0.04	13.2	4	0.55			3.07 2.00							7.05 7.12		14,100	9,86	1. 503.
2-06	840	1540 1770	1.08	.440	1,200	0.4 0.5	770	670 2,	.150	56.8	29.8	2.94	2	0.12	78.0	681	1610	7.43	0.12	0.10	0.11		1.32																				-1	З.
-06		1610 (1560 (380	330	0.5 0.4	898	206 5		-			-		126.0	ωi	1510	7.50	0.10 0.06		0.06		0.80 1.54	0.83 0.79	0.89	21.0	8.38 1	1.01	5.1	0.35	6.6		5.27 5.40	0.126	11	7	10,000	800	1,570	6.93	8,000	13,040	9,40	
-06 -06		1760 1590	.10	347	260	0.5									150.0 174.0		1480	7.48 7.59	0.11 0.06	0.06 0.06	0.09		1.33 2.35		0.59	12.0							5.87	0.131					1,490	6.85	8,400	14,500	10,48	0. 300.
-06		1630	.08		200	0.5 0.4		175 5	586						198.0 222.0			7.46 7.49	0.12 0.10	0.08			1.19 1.29		0.36	21.0							6.00 6.27				11,200					17,260	12,62	0. 20 0
-06 -06		1610 1 1680 1		88	72	0.4 0.3	166	192 3	62	60	26.5	0.05	33.5	4 21	246.0 270.5		1640	7.45	0.12	0.11	0.12		1.16																					0.
07 07		1720 1 1690 1		.500	1,180	0.2 0.3	195	293 1,							293.5				0.08 0.12	0.08 0.08	0.10	0.20	1.18 0.86	0.56 0.63	0.98	16.0	0.04 Ç	0.01	20.8	0.34	7		5.53 (4.53	0.138	3	4	9,400		1,930	6.7	10,100	15,860	10,280	04.
07 07		1690 1 1780 1	.08		730	0.1 0.2									317.5 341.5		1700	7.46 7.44	0.17 0.20	0.12 0.24	0.15 0 <u>.22</u>		1.12 1.33		0.20	22.0								0.144					1,600	7.08	12,600	17,300	12,70	1. 03.
07 07		1710 7	.13		/00	0.3		319 1,	330						365.5 390.0			7.38 7.45	0.17 0.10	0.20 0.13			2.63 1.38		1.00	8.0	6.66						5.33									15,700	11,460	4. 02
97		1690 7 1610 7	.00 1,	,520	1,090	0.4 0.1	596	542 2,	240		29.2	0.02	70.9	3.58	414.0 437.5		1600	7.48	0.12 0.29	0.11	0.12		2.29																					2. 2.
07 07		1660 7 1660 7		.040	78 0	0.2 0.3	696	444 1,							461.5 485.5			7.42	0.11		0.11	0.60	0.57	1.05 0.91	0.48	18.0	4.14 0).84	11.0	2.12	6.6		6.40 (5.87	0.135	8	2	6,000		1,260	7.14	10,800	16,040	11,560	0 3.
07 07		1590 é 1690 7		,253	747	0.3 0.2									509.5		1640		0.26 0.28		0.21 0.28		2.04 2.05		0.41	8.0	4.15					:	2.33 (6.20	0.118					1,540	7.17	11,200	19,400	14,030	
07 07		1630 7 1510 6	.06	,200		0.3		412 1,	034						533.5 557.5				0.48 0.40	0.23 0.28			2.03 0.78		0.22	39.0	2.37						4.87									18,900	13,867	3. 72.
07		1740 7	.25 1	150	106	0.3 0.2		162 4	09	47	27.2	0.10	61	1.67	582.0 605.5	925.0	1590		0.20 0.29	0.19 0.13	0.20	0.50	0.74	1.43	0.80	17.0	10.0	~ 4		•														1. 1.
07 07		1700 7 1620 7	.07 3	312	224	0.2 0.3	502	191 5	94						629.5 653.5			7.40	0.32	0.25	0.29	. 0.00	2.09	0.64			18.8	0.1	12.5	0.05	8.7		5.40 (4.73	0.110	6	2	1,500	90 0	1,590	7.14	12,200	16,250	12,050	0 2. 2.
07 07		1630 7 1670 7		60	128	0. <u>2</u> 0.1		186 4	74						677.5 701.5		1000	7.27	0.17		0.20 0.17		2.34 1.53			21.0							5.87 (6.00	0.131					1,530	7.16	11,500	17,1 0 0	12,600	2.
07 07		1600 7 1600 6				0.3 0.3			• •						725.5			7.28 7.40			(1) (1)		0.93 1.83		0.56	20.0	3.83						5.47									16,400	12,300	2.0
07 07		1610 7 1640 7	.05 8	07	628	0.3		330 1,3	333	:	26.5	ND	101	13.5	749.5 773.5		1640	7.03 6.9			(1) (1)	0.2	2.00 2.64	0.35	0.15	27.0	2.22	16.1	8.7	3.1	•	20 3			4 60									1.! 1.i
97		1520 7	.02 3	05	250	0.1	200	221 5	22						797.5 821.5		1500	7.31 7.24			(1)		1.66 1.43	0.56					Q .7	3.1	a	5	5.13	0.18 1	1.00	1.00	1,700		1,350	6.90		13,750	10,000) 3.1 3.1
37 37		1590 7 1540 7	.07 1	87	140	0.2 0.3	•	145 5	02						845.5 869.5			7.34 7.24			(1) (1)		0.94	0.00			1.65	4	• .			5	5.27 (5.87	0.16					1,500	7.00		14,400	10,650) 3. ⁻ 2.9
07 07		1510 7 1530 7				0.2 0.2									893.5 917.5			7.3			(1) (1)		3.21 2.75		0.47	32.0	2.73					e	5.00							7.14		14,440	10,500	
37 37		1640 7 1700 7		00	120	0.3 0.3		3	92		25.5 ·				941.5		1460				(1) (1)	1	2.57 2.74			25.0	1.87							0 16 ·	5.03	100	2900.00		1 000					2.
17 17		1690 7 1670 7	.14 2	90	220	0.2		4	18	15.4		ND	109	28.1	965.5 969.5		1630 1320				(1) (1)		1.65 2.90				2.07	Ģ .4	2.9	1.3	9.3	25 5	5.27		0.00				1,200				11400	2.6
8		1650 7	.11 1	90	130	0.3 0.2		4	58	2	24.5				1013.5 1037.5			7.1 7.14			(1) (1)		2.95 2.71			21.0						1	.67	0.16					1,240	7.12		15300	11050	
)6)8		1660 7 1660 7	18			0.3 0.2									1061.5 1085.5			7.27 7.27			(1)		4.52			21.0	0.80						1.73 3.8									14700	10600	
18 18		1410 7 1570 7	15	67	133		196 1 268	178 43	32 5	6.4 2	26.8	ND	25	4.8	1109.5 1133.5	1022.0	1540	7.28			(1) (1)	0.67			0.53	4.0	1.07 1	9.1	1.3	3.4	7.6	20 6	1.07 0	.144				1000	1,410	7 19		14150	10350	;
8		1570 7. 1590 7		20	220	0.3 0.3		73 57	79						1157.5		1420				(1) (1)		1.73 2.71	1.51	0.04	38.0	0.41					4	1.07 1.73 0											3
8		1570 7 1670 7	73 4	27	293	0.3	2	26 73	36						1181.5 1205.5				0,14 0.15	0.35 0.1	0.25		3.86 3.84			15.0						4	.67						1,400	7,1				4
38		1590 7	.1			0.2 0.3									1229.5 1253.5			7.17	0.13	0.31	0.22		2.58 1.86									4	.73									12850 12850	9450 9450	3
38 38		1510 8. 1600 7.		60	330		228 2 395	20 73	38 4	3.4 2	26.6	ND	46		1277.5 1301.5		1370	7.3	0.18	0.07		0.4	2.34		0.34	17.0	0.07 1	5.8 <1		7.0	7.5	206	.33 0	.138	8	6 6	300.00		1,380	7.06				3
8		1520 7. 1540 7.		40	270	0.3 0.3		58 64	14						1325.5		1450		0.13		0.09		3.86	0.65	0.77	15.0	0.09						5.8 5.4 0											
8		1430 7.		40	160	0.2	1	40 45	58						1349.5 1373.5				0.04 0.13				2.82 1.76			22.0							4.8						1,390	7.00		13700	10300	2

TABLE B-6

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Appendix C. Laboratory Reports

Source Water Data

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CH2M HILL 2300 NW Wainut Slvd. Corvalis. CR 97330-3538 Maxing accress: P.O. Box 428 Corvalis. CR 97339-0428 Tel 541.752.4271 Fax 541.752.0275

June 30.1997

City of McAllen

138067.A0.ZZ

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RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5440 and 5590

Jim Geisbush/PHX

On June 3.1997. the CH2M HILL Corvallis Applied sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy. your samples will be stored for 30 days after reporting. If you have nor given us prior instructions for disposal. we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward co serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235. extension 3 120.

Sincerely,

(MIL

Kelly Ensor Senior Administrative Assistant

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Enclosures

CLIENT SAMPLE CROSS-REFERENCE

CVO Sample D	Client Sample ID	Date Collected	Time Collected	-
%001	Lake?	06/02/1997	11:45	
55900 1	Lake2 3D	6/21/97	12: 16	

CH2M KILL Applied Science Laboratory Reference No. 5440 and 5590

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CASE NARRATIVE DBPs

Lab Reference No.: 5590

Client/Project: City of McAllen

L Holding Times: All acceptance criteria were.

II. <u>Analysis</u>:

- A. Au acceptance criteria were ma
- B. Blanks: All acceptance criteria were met.
- C. <u>Duplicate Sample(s)</u>: All acceptance criteria were mer.
- D. <u>Spike Sample(s)</u>: AR acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.
- E. <u>Surrogate</u> Recoveries All acceptance criteria were ma
- F. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
- G. <u>Other</u>: None
- III. <u>Documentation</u>Exceptions: None
- IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy dam package has been authorized by the Laboratory Manager or designee. as verified by the following signature.

Singer Collins Prepared by: Reviewed by: .

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APP-21

CASE NARRATIVE FORMATION POTENTIAL

Lab Reference No.: 5440

Client/Project: City of McAllen

-

- I. <u>Holding Time</u>: Formation potential was set up 16 days after sample collection.
- II. <u>pH / CI residual analysis:</u>
 - A. <u>Calibration</u>: All acceptance criteria were met.
 - B. <u>Blanks</u>: All acceptance criteria were met.
 - C. <u>Other</u>. The added precursor blank had a recovery of 139%.
- IV. <u>Documentation Exceptions</u>: None

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____ (ollins_____

CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5440

Client/Project: City of McAllen

- L. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions:</u> None
- III. <u>Analysis</u>:
 - A. <u>Calibration</u>: All acceptance criteria were met.
 - B. <u>Blanks</u>: All acceptance criteria were met.
 - C. <u>Marrix Spike Sample(s)</u>: All acceptance criteria were met.
 - D. <u>Duplicare Sample(s)</u>: All acceptance criteria were mer.
 - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
 - F. <u>Other</u>. Not applicable.
- Iv. <u>Documentation Exceptions</u>: None.

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signamre.

Prepared by:	Helen 26n Here	
	by: Jours & Jone	

CASE NARRATIVE METALS

Lab Reference No..: 5440

...

Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. <u>Analysis</u>:
 - A. <u>Calibration</u>: All acceptance criteria were ma
 - B. <u>Blanks</u>: All acceptance criteria were ma
 - C. <u>ICP Interference Check Sample:</u> All acceptance criteria were met.
 - D. <u>Spike Sample(s)</u>: All acceptance criteria were met.
 - E <u>Duplicare Sample(s)</u>: All acceptance criteria were mer.
 - F. <u>Laboratory Control Sample(s)</u>: All acceptance criteria were met except Silicon which had a recovery of 131%.
 - G. <u>ICP Serial Dilution:</u> Not Required.
 - H. <u>Other</u> • None

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IV. <u>Documentation Exceptions</u>: None

V. I certify that this data package is in compliance with the terms and conditions agreed m by the client and CH2M HILL. both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee. as verified by the following signature.

he kai Prepared by: Reviewed by:

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Client Information			Lat	Information		······
Project Name:	Cii of McAlle	n Pilot Stud	y	Dam Rec'd		
Project Manager:	Patrick Asogv	a	-		544001	
Sampled ay:	M. Salazar		Report	Revision No.;		
Client Sample ID:	Lake2				HVN and KD.	J
Sampling Dale:	6/2/97			Reviewed By		_
Sampling lime:	sea Chain of	Custody				
Туре:	Grab					
Matrix:	Water					
Basis:	As received					
	Reporting	Sample				Date
nalyte	Limit	Result	Qualifier	Units	Method	Analyzed
Chemistry		1000				
Jkalinity		1060		mg/L	EPA 310.1	6/1 1/97
licarbonate		1060		mg/L	EPA 310.1	6/11/97
arbonate	1.0	1.0	U	mg/L	EPA 310.1	6/11/97
romide	0.03	0.54		mg/L	EPA 300	6/20/97
hioride	2.50	201		mg/L	EPA 300	6/5/97
clor (ALPHA) Apparent	5	10		color units	EPA1 102	6/4/97
olor w-254	0.009	0.092		abs/cm	SM 5910	6/4/97
luoride-Free	0.10	0.99		mg/L	EPA 300	6/4/97
-Nile	0.10	0.10	U	mg/L	EPA300	6/4/97
-i-oral Phosporus	0.05	0.05	U	mg/L	EPA 365.1	6/9/97
otal Dissolved Solids	1	772		mg/L	EPA 160.1	6/9/97
Sulfate	250	262		mg/L	EPA 300	6/5/97
°OC	0.50	3.9		mg/L	EPA 415.1/2	6/9/97
letals						
Numinum, I C P	42.1	248		µg/L	EPA 200.7	6/16/97
arium. ICP	0.53	124		µg/L	EPA ZOO.7	6/16/97
alcium, ICP	49.7	77.700		μg/L	EPA 200.7	6/16/97
on. ICP	17.8	171		µg/L	EPA 200.7	6/16/97
lagnesium, ICP	292	27.900		μg/L	EPA 200.7	6/1 6/97
langanese. ICP	0.8	17.8		µg/L	EPA 200.7	6/16/97
otassium. ICP	275	9,580		µg/L	EPA 200.7	6/16/97
ilicon. ICP	110	6.300		μg/L	EPA ZOO.7	6/17/97
Sodium. ICP	135	140,000		μg/L	EPA 200.7	6/16/97
trontium. ICP	9.4	2.400		μg/L	E?A 200.7	6/17/97
	0.4	_			2.77 200.1	Q Q .

(541) 752-4271 Fax No.(541) 752-0276

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Project Manage Sampled B Client Sample I Sampling Dat Sampling Tim Typ Matri	te: 6/2/97	ilot Study	Å	Lab Information Date Rec'd: (Lab ID: 5 Analysis Method: 5 ort Revision No.: (Reported By: 4 Reviewed By: 4	544001 SM 5710.D DAH
A/THM Formation P Set-up Date/Time	otential Test Conditi Target Contact Time	ons Initial pH	. Contact	Contact Temperature (*C)	Chiorine Dosage (mc/L)
6/18/97 16:08	3 days	7.6	7.6	25	6.50
orine Demand Test Take-off Date/Time	Results Contact Time		Measured pH	Measured Temperature ccl	Chlorine Residua (mg/L)
6/21/97 1216	68:08		7.8	25	0.30
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		-			

Appled Sciences Lcoon Corvalis Office

Client Sampled By: Client Sampled By: Client Sampled By: Sampling Date: Sampling Time: Type: Matrix: Basis: A	Patrick Asogw D. Hardy Lake2 30 5/21/97 1216 Grab		Report	Lab ti Revision Na Reported Sy Reviewed By	d: 6/23/97 D: 559001 h:: 0 y: OAH
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Haloacetic Acids - SM 6251.	9				
Chloroacatic acid	79-11-8	0.5	3.3		6/24/97
Bromoacetic acid	A-06-3	0.5	53		6/24/97
Dichloroacetic acid	79-43-5	0.5	152		6/24/97
Trichlorgacetic acid	76-03-9	0.5	8.9		6/24/97
Bromochioroacetic acid	5589-96-3	a.5	20.1		6/24/97
Dibromoacetic acid	631-64-t	0.5	18.6		6/24/97
2.3-Dibromopropanoic acid	600-05-5		115%	SS	
Trihalomethanes - EPA 502.2	2				
Chloroform	67-66-3	0.5	35.3		6/23/97
Bromodichloromethane	75-27-4	05	63.7		6/23/97
Dibromochioromethane	124-48-1	a.5	81.3		6/23/97
Bromoform	75-25-2	05	34.3		6/23/97
1.2-Dichloroethane-d4	17068-07-0		94%	S S	
					-
<u></u>					
		. <u></u>			
SS=Surrogate standard U=Not detected at specified :					

Acciled Sciences Locoratory

2300 NW Wainut Blvd., Corvatis, OR 97320-3538 P.O. Box 428, Corvatis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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CH2MHILL Analylical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

 I LMG 2567 Faktane Drive
 I LRD 5090 Caterpillar Road
 I LLKW Cenviro Analytical Laboratories, Inc.
 I 16VD 2300 NW Walnut Boulevard

 Montgomary, AL 36116-1822
 Redding, CA 66003-1412
 50 Bathurst, Unit 12, Waterico, Ontario, Canada N2V 2C5
 Gorvalus, OR 97330-3638

 (334) 271-1444
 FAX (334) 271-3428
 (916) 244-6227
 FAX (916) 244-4109
 (518) 747-2675
 FAX (619) 747-3806
 (541) 752-4271
 FAX (541) 752-0276

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June 27, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Dam for City of McAllen CVO Laboratory Reference No. 5440 and 5590

Jim Geisbush/PHX

On June 3, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received one sample with a request for analysis of selected parameters.

The **analytical results** and associated **quality control data are** enclosed. Any unusual **difficulties** encountered during the **analysis** of your **samples are discussed in** the case narrative.

Under **CH2M HILL** policy, your samples will **be** stored for 30 days after **reporting**. If you have not given us prior **instructions** for disposal. we **will contact** you if **any** samples require **disposal** as hazardous waste.

The **CH2M** HILL Applied Sciences **Laboratory appreciates** your **business** and looks forward to sewing your analytical needs **again**. If you should have any questions concerning the **data**, or if you need additional **information**, please **call** Ms. Kathy **McKinley** at (541) **758-0235**, extension 3 120.

Sincerely,

allerEnan

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory / Corvallis Office

2300 NW Walnut Blva., Corvallis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276 CH2RMHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

| | LMQ: 2567 Faktane Ditve Monigorney, AL: 36116-1622 (334) 271-1444 - FAX (334) 271-3426

i İLRD 5000 Ceterpiller Road I İLKW Cewvire Analytical Laboratories, Inc. Redding, CA 66003-1412 60 Bethurst, Link 12, Waterloo, Dotario, Canada N2V 2C5 (916) 244-5227 FAX (U16) 244-4109 (519) 747-2675 FAX (519) 747-3808

GCV0 2300 NW Walked Boulevard . * Colvulus, OR 97330-3634 (641) 752 4271 FAX (641) 752 0276

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Sampling C G W S A O R A O I M A T I R	CLIENT SAMPLE ID	LAB		<i>H</i> 2504	Louc	Ualle	Vove	U o U C			Cooler Temperature		·····
MATIA	(9 ÇHARACTERS)	ac	, a		2	2	Ö	6					
Date Time P B E L	·			1	~~	2	コ	2			Alternate Descri	plion	Leb ID
6-1-57 11:45A V La	KP2		11	·	T					1	······································		N
6-2-11 11:30+ 11 6		·	2		· · ·				• •• •• ••				
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6-2-11 11.15 1 1 1 6 9	K C 2		!		.Y]								/
6-2-91 11 36 11 1 6 6	KCZ		t I 🔡		.	\checkmark				1			
6-2-47 111 40 VV Ka	KCS		i				\checkmark					·	17
6-2-97 4146 VV La			i			•••••	· ·				* * *** *		1^{-1}
6 6 7 14 93 7 99 1 1 1 1 1 1 1 1 1		1 U	• • •	1.7	· · · ·						· • ··· ··- ·.	-	· · · · · · · · ·
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Bampled By and Tille May fin	SALEZAY 6-2-	lma Re	MALLS	Y A			Photos to	an ar d print	Normal .	Date/F			
Illant Sha Illartis	DALEZAN 63-	<u>87 12:0</u>	111146	aline	~				<u>elazar</u>		6-2-97 12:0	7/) 	<u> </u>
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Special Instructions:			ŀ						•	1	untact : Gu		
I <u></u>	· · · · · ·										THE OWNER THEY	11/1-1 1/1/	n 1 01 1

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5440 and 5590

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
544001	Lake2	6/2/97	11:45
559001	Lake2 3D	6/21/97	12:16

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CASE NARRATIVE DBPs

Lab Reference No.: 5590

Client/Project: City of McAllen

L Holding Times: All acceptance criteria were.

II. <u>Analysis</u>:

- A. <u>Calibration</u>: All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- C. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- D. Spike Sample(s): All acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.
- E. <u>Surrogate Recoveries</u>: All acceptance criteria were met.
- F. Lab Control Sample(s): All acceptance criteria were met.
- G. <u>Other</u>: None

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- III. <u>Documentation Exceptions</u>: None
- IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: _____

CASE NARRATIVE

FORMATION POTENTIAL.

Lab Reference No.: 5440

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Client/Project: City of McAllen

- L Holding Time: Formation potential was set up 16 days after sample collection.
- IL <u>pH / Cl residual analysis</u>:
 - A. <u>Calibration</u> All acceptance criteria were met.
 - B. Blanks: All acceptance criteria were met
 - C. <u>Other:</u> The added precursor blank bad a recovery of 139%.

IV. <u>Documentation Exceptions</u> None

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions derailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

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CASE NARRATIVE GENERAL CHEMISTRY

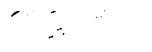
Lab Reference No.: 5440

• •

Client/Project: City of McAllen

- I. <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:
 - A. <u>Calibration</u>: All acceptance criteria were met.
 - B. <u>Blanks</u>: All acceptance criteria were met.
 - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
 - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
 - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
 - F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in **compliance** with the **terms** and conditions agreed to by the client and **CH2M** HILL, both **technically** and for **completeness**, except for the **conditions** detailed above. Release of the data **contained** in this hardcopy data package **has** been authorized by the **Laboratory** Manager or his designee, **as** verified by the following signature.

Prepared by: _____



CASE NARRATIVE METALS

Lab Reference No.: 5440

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Client/Project: City of McAllen

- L Holding Time: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:
 - A. <u>Calibration</u>: All acceptance criteria were met.
 - B. <u>Blanks</u>: All acceptance criteria were met.
 - C. <u>ICP Interference Check Sample:</u> All acceptance criteria were met.
 - D. <u>Spike Sample(s)</u>: All acceptance criteria were met.
 - E. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
 - F. <u>Laboratory Control Sample(s)</u>: All acceptance criteria were met except Silicon which had a recovery of 131%.
 - G. <u>ICP Serial Dilution</u>: Not Required.
 - H. . Other: None
- IV. <u>Documentation Exceptions</u>: None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy dam package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

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Client Information			La	b.inf		
	City of McAlle	n Pilot Stud		Date Rec'd:	6/3/97	
Project Manager.	Patek Asogw	ra.		Lab ID:	544001	
Sampled By:	M. Salazar		Report	Revision No.:	0	
Client Sample ID:	Lake2			Reported By:	HVN and KOJ	
Sampling Date:				Reviewed By:		
Sampling I-ii: S		Custody				
Type:						
Matrix						
Basis:	As received					
	Reporting	Sample				Date
nalyte	Limit	Result	Qualifier	Units	Method	Analyzed
Themistry						
Ikalinity		1060		mg/L	EPA 310.1	6/11/97
icarbonate		1060		mg/L	EPA 310.1	6/11/97
arbonate	1.0	1.0	U	mg/L	EPA 310.1	6/11/97
romide	0.03	0.54		mg/L	EPA 300	6/20/97
hioride	260	201		mg/L.	E P A 3 0	0 6/5/97
olor (ALPHA) Apparent	5	10		color units	EPA110.2	6/4/97
olor w-254	0.009	0.092		abs/cm	SM 5910	6/4/97
luoride-Free	0.10	0.99		mg/L	EPA 300	6/4/97
-Nitrate	0.70	0.10	U	mg/L	EPA300	6/4/97
-Total Phosporus	0.05	0.05	U	mg/L	EPA 366.1	6/9/97
otal Dissolved Solids	1	772		mg/L	EPA 160.1	6/9/97
ulfate	2.50	262		mg/L	EPA 300	6/5/97 0/0/07
oc	0.60	3.9		mg/L	EPA 415.1/2	6/9/97
leta/s				_		
luminum, ICP	421	246		µg/L	EPA 200.7	6/16/97
arium, ICP	0.53	124		µg/L	EPA 200.7	6/16/97
alcium, ICP	49.1	77,700		µg/L	EPA 200.7	6/16/97
on, ICP	17.6	171		µg/L.	EPA 200.7	6/16/97
lagnesium, ICP	262	27,900		µg/L	EPA 200.7	6/16/97
langanese, ICP	0.6	17.6		µg/L	EPA 200.7	6/16/97
otassium, ICP	276	9,580 6 200		µg/L	EPA 200.7	6/16/97 6/17/97
ilicon, ICP	110	6.300		µg/L	EPA 200.7	6/17/97
odium, ICP	136	140,000		µg/L	EPA 200.7 EPA 200.7	6/16/97 6/17/97
trontium, ICP	9.4	2,400		µg/L	EFA 200./	11111

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			У		
Gliant Informatio				ab information	
Project Nam	e: City of McAllen P	ilot Study	_	Date Rec'd:	6/3/97
	R: Patrick Asogwa	·		Lab (0: 1	544001
	y: M. Salazar		A	Analysis Method:	SM 5710.D
Client Sample II	•			ort Revision No.: (
Sampling Dat				Reported By: I	DAH
Sampling Tim				Reviewed By:	
Тур	e: Grab				
Matri	ix: Water				
Basi	s: As Received				<u></u>
IAA/THM Formation P	otential Test Conditi	ions		• • •	·
_	- ·		• • •	Contact	Chlorine
Set-up	Target	Initial	Contact	Temperature	Dosage
Date/Time	Contact Time	pH	pH	("C)	(mg/L)
6/18/97 16:08	3 days	7.6	7.6	25	6.50
Chlorine Demand Test	Results			Measured	Chlorine
Take-off			Measured	Temperature	Residual
Date/Time	Contact Time		рH	("C)	(mg/L)
6/21/97 12:16	68:08		7.8	25	0.30
•					
<u> </u>					

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 Corvatils Office
 P.O. Box 428, Corvatils, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

<u>Cilippopect Name</u> Project Manager Sampled By Client Sample ID: Sampling Date Sampling I-ma Type Matrix Basis	Lab Information Date Rect: 6/23/97 Lab ID: 559001 Report Revision No.: 0 Reported By: DAH Reviewed By: Units: µg/L				
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Heloacetic Acids - SM 625	1 D				
Chloroacetic acid	79-11-8	0.5	32		6/24/97
Bromoacetic acid	79-08-3	05	5.3		6/24/97
Dichloroacetic add	79-43-6	05	152		6/24/97
Trichloroacetic acid	75-03-9	05	8.9		6/24/97
Bromochloroacetic acid	5589-96-3	0.6	20.1		6/24/97
Dibromoacetic add	631-64-l	0.6	18.6		6/24/97
2,3-Dibromopropanoic ad	id 600-05-5		11.5%	SS	
Trihalomethanes - EPA 50					
Chioroform	<u></u> 67-66-3	0.5	36.3		6/23/97
Bromodichloromethane	75274	0.5	b3.7		6/23/97
Dibromochioromethane	124-w-l	05	81.3		6/23/97
Bromoform	75-25-2	05	34.3		6/23/97
1,2-Dichloroethane-d4	17068-07-0		94%	SS	
·					
		-			
SS=Surrogate standard					
U=Not detected at specifie	d reporting limits				

Applied Sciences Laboratory _ _ Corvailis Office 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 **t** -

Client Information Project Name: City of McAilen Project Manager: Jim Geisbush/PHX Sampled By: R. Villareal Cilent Sample ID: Feedwater Sampling Date: 5/19/97 Sampling Time: 10:40 Type: Grab Matrix: Water Basis: As Received			Â	ab Date Rec'd: 9 Lab ID: 9 ID:	535701 SM 5710.D
A/THM Formation i Set-up Date/Time	Potential Test Conditi Target Contact Time	ions Initial pH	Contact	Contact Temperature (°C)	Chiorin Dosage (mg/L)
6/2/97 15:04	72:00	7.3	7.8	23	10.00
lorine D-d Test Take-off Date/Time	Results		Measured pH	Measured Temperature (°C)	Chlorine Residua (mg/L)
6/5/97 9:38	66:34		7.6	23	1.12
•		-			

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Project Name: City of McAllen Project Manager: Jim Geisbush/PHX Sampled By: R. Villareal Client Sample ID: Memcor Filtrate Sampling Date: 5/19/97 Sampling Time: 10:40 Type: Grab Matric Water Basis: As Received			Lab Date Rec'd: 5/20/97 Lab ID: 535702 Analysis Method: SM 5710.D Report Revision No.: 0 Reported By: DAH Reviewed By:				
AAATHM Formation F Set-up Date/Time	Potential Test Condit Target Contact Time	ions Initial pH	Contact	Contact Temperature (°C)	Chiorine Dosage (mg/L)		
6/2/97 15:11	72:00	7.3	7.8	23	10.00		
Chlorine D - d Tes Take-off Date/Time 6/5/97 14:40	Contact Time 71:29		Measured pH 7.7	Measured Temperature (°C) 23	Chlorine Residual (mg/L)		
ſ							
J ≕Nat detected at spe ≁ ciences Laboratory			1111s OR 97330-353				

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Cilent Internetio	<u> </u>		Ļ			
	: City of McAllen			Date Rec'd: 5	/20/97	
Project Manager	r: Jim Geisbush/PH	x	Lab ID: 535703			
	r: R. Villareal		Analysis Method: SM 5710.0			
): Zeeweed Permea	ite	Repo	Art Revision No.: 0		
Sampling Date				Reported By: [HAC	
Sampling Time				Reviewed By:		
	a: Grab c Water					
	s: As Received					
				······		
HAA/THM Formation Po	otential Test Conditi	ons				
				Contact	Chlorine	
Set-up	Target	Initial	Contact	Temperature	Dosage	
Date/Time	Contact Time	pH	pH	(°C)	(mg/L)	
6/2/97 15:19	72:00	8.0	7.8	23	10.00	
Chlorine Demand Test (Centin					
	1630/63			Measured	Chlorine	
Take-off			Measured	Temperature	Residual	
Date/Time	Contact Time		pН	(°C)	(mg/L)	
6/5/97 14:47	71:28		7.6	23	<u>0.44</u>	
ć						
-		-				

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Project Manager Sampled By Client Sample ID Sampling Date Sampling Time Type Matrice	City of McAllen Jim Geisbush/P D. Hardy FEEDWATER (6/5/97	Lab Report	6/5/97 546701 1 DAH		
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Haloacatic Acids - SM 6251	.B				•••
Chloroacetic acid	 79-11-8	0.5	7.9		6/24/97
Bromoacetic acid	79-08-3	0.5	8.7		6/24/97
Dichloroacetic acid	79-43-6	0.5	28.4		6/24/97
Trichloroacetic acid	76-03-9	0.5	15.8		6/24/97
Bromochloroacetic acid	5589-96-3	0.5	34.4		6/24/97
Dibromoacetic acid	631-64-I	0.5	26.3		6/24/97
2,3-Dibromopropanoic acid	600-05-5		134%	SS	
Tirihalomethanes - EPA 502	2.2				
Chloroform	67-66-3	0.5	452		6/9/97
Bromodichloromethane	75-27-4	0.5	89.8		6/9/97
Dibromochloromethane	124-48-1	0.5	130	E	6/9/97
Bromotorm	75-25-2	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-0		90%	SS	
E-Exceeded instrument ca SS-Surrogate standard U-Not detected at specified	-				

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Project Managen Sampled By Client Sample ID Sampling Date Sampling Time Type Matrix	: D. Hardy : FEEDWATER : : 6/5/97	ΉХ	Report	Information Date Rec'd Lab ID Revision No. Reported By Reviewed By Units	: 6/5/9 : 54670 : 0 : DAH	
naiyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date	Analyzed_
aloacatic Acids - SM 625	1 R					7
hioroacetic acid	79-11-8	0.5	5.5			6/10/97
romoacetic acid	79-08-3	0.5	a6			6/10/97
· • •		0.5				
ichloroacetic acid	79-43-6		29.1			6/10/97
nchloroacetic acid	76-03-9	0.5	13.9			6/10/97
romochloroacetic acid	5589-96- 3	0.5	39.6			6/10/97
ibromoacetic acid	631-64-l	0.5	30.5			6/10/97
, 3-Dibromopropanoic a c	id 600-05- 5		194%	SS		
inhalomethanes - EPA 50	22					
hloroform	67-66-3	0.5	46.2			6/9/97
romodichloromethane	75-27-4	0.5	69.6			6/9/97
bromochloromethane	124-48-1	0.5	130	Ε		6/9/97
romotorm		0.5	67.7	E		6/9/97
romolorm	75 -25- 2	0.5	07.7			0/3/97
,2-Dichloroethane-d4	17068-07-0		90%	SS		
=Exceeded instrument ca) - -				
=Exceeded instrument ca iS=Surrogate standard J=Not detected at specifie	_					

Applied Science Corvatis Office

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Project Name: C Project Name: C Project Manager: J Sampled By: D Client Sample ID: M Sampling Date: 6 Sampling Time: 1 Type: C Matrix: V Basis: A	im Geisbush/f). Hardy AEMCOR 3D /5/97 4:40 àrab	Labinormation Date Rect: 6/5/97 Lab ID: 546702 Report Revision No.: 1 Reported By: DAH Reviewed By: Units: µg/L			
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Haloacatic Acids - SM 6251.1	3				
Chioroacetic acid	79-11-8	0.6	6.6		6/24/97
Bromoacetic acid	79-08-3	0.5	10.7	.84	6/24/97
Dichloroacetic acid	7943.6	0.6	36.3	184	6/24/97
Trichloroacetic acid	76-03-9	0.6	13.3		6/24/97
	5589-96-3	0.6	41.8		6/24/97
Dibromoacetic acid	631-64-1	0.6	34.3		6/24/97
2.3-Dibromopropanoic acid	600-05-5		122%	66	
Trihalomethanes - EPA 502.2	?				
Chloroform	67-66-3	0.6	46.3		6/9/97
Bromodichloromethane	75-27-4	0.5	89.3		6/9/97
Dibromochloromethane	12446-I	05	124	E	6/9/97
Bromoform	75-25-2	0.6	64.6		6/9/97
1.2-Dichloroethane-d4	17068-07-0		93%	SS	
		-			
E=Exceeded instrument calib SS=Surrogate standard	pration range				

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Cilent Information Project Name: Project Manager: Sampled By: Client Sample ID: Sampling Date: Sampling Time: Type: Matric: Basis:	Jim Geisbush/I D. Hardy MEMCOR 3D 6/5/97 14:40 Grab	Lab Information Date Rec'd: 6/5/97 Lab ID: 546702 Report Revision No.: 0 Reported By: DAH Reviewed By: Units: µg/L			
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed
Haloacetic Acids - SM 6251.	8				
Chloroacetic acid	79-11-8	0.5	6.4		6/10/97
Bromoacetic acid	79-08-3	0.5	9.4		6/10/97
Dichloroacetic acid	79-43-6	OS	30.3		6/10/97
Trichloroacetic acid	76-03-9	OS	a2		6/10/97
Bromochioroacetie Cid	5589-96-3	0.5	41.4		6/10/97
Dibromoacetic acid	631-64-1	0.5	34.9		6/10/97
2,3-Dibromopropanoic acid	600-05- 5		107%	SS	
Trihalomethanes - EPA 502.	2				
Chioroform	67-66- 3	OS	46.3		6/9/97
Bromodichioromethane	75-27-4	OS	69.3		6/9/97
Dibromochioromethane	724-48-l	0.5	124	E	6/9/97
Bromoform	75-25-2	0 S	64.8		6/9/97
1,2-Dichloroethane-d4	17068-07-0		93%	SS	
		-			
E=Exceeded instrument cali SS=Surrogate standard U=Not detected at specified	-	5			

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Project Name: City of McAllen Project Manager: Jim Geisbush/PHX Sampled By: D. Hardy Client Sample ID: ZEEWEED 3D Sampling Date: 6/5/97 Sampling Time: 14:47 Type: Grab Matrix: Water Basis: As Received				Later Rec'd: 6/5/97 Lab ID: 546703 Report Revision No.: 1 Reported By: DAH Reviewed By: Units: µg/L			
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed		
Haloacetic Acids - SM 6251.I	3						
Chloroacetic acid	79-11-8	0.5	9.3		6/24/97		
Bromoacetic acid	79-08-3	0.3	12.2		6/24/97		
Dichloroacetic acid	79-43-6	0.9	243		6/24/97		
Trichloroacetic acid	76-03-9	0.5	16.4		6/24/97		
Bu₋acid	5589-96- 3	0.9	34.1		6/24/97		
Dibromoacetic acid	631-64-1	0.5	293		6/24/97		
2,3-Dibromopropanoic acid	600-05-5		104%	SS			
Trihalomethanes - EPA 502.2	2						
Chloroform	67-66-3	0.5	38.9		6/9/97		
Bromodichloromethane	75-27-4	0.5	i7.4		6/9/97		
Dibromochloromethane	12443-1	0.5	113	E	6/9/97		
Bromotorm	75-25-2	0.5	W.I		6/9/97		
1.2-Dichloroethane-d4	17003-07-0		99%	SS			
		-					
E=Exceeded instrument calib	ration range						
S=Surrogate standard J=Not detected at specified r							

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<u>Client_Information</u> Project Name:			Lab	Inf Date Rec'd:	6/5/97
Project Manager:		йНХ			546703
Sampled By: 1	•			Revision No.:	
Client Sample ID: 2				Reported By:	
Sampling Date:			F	Reviewed By:	
Sampling Time:				Units:	µg/L
Type: (
Matrix:					
Basis; .	As Received				
		Reporting	Sample		
nalyte	CAS #	Limit	Result	Qualifier	Date Analyzed
aloacetic Acids - SM 6251.	-	0 F	- /		
nloroacetic acid	79-11-8	0.5	7.4		6/10/97
omoacetic acid chloroacetic acid	79-08-3 7943%	0.5 0.5	13.8		6/10/97
chloroacetic acid	7943% 76.03%	0.5 05	25.8 124		6/10/97
omochloroacetic acid	76.03% 5589-96-3	US 0.5	1 24 36.4		6/10/97 6/10/97
bromoacetic add	631-64-1	0.5	30.4 312		6/10/97
auu auu		0.0	512		
3-Dibromopropanoic acid	600-05-5		104%	SS	
ihalomethanes - EPA 502.	2				
hloroform	67-66- 3	05	38,9		6/9/97
romodichloromethane	75-27-4	0.6	77.4		6/9/97
promochioromethane	124-48-1	0.5	113	E	6/9/97
motorm	75-25-2	0.5	60.1		6/9/97
-Dichlorosthane-d4	17068-07-0		95%	SS	
	:	-			
Exceeded instrument cali	bration range				
=Surrogate standard Not detected at specified					

Applied Sciences Laboratory Corvatilis Office

2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

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CH2M HILL 2300 NW Walnut Blvd. Corvatilis DB 97330-3538 Mailing address: 20. Box 428 Convatiis OB 97339-0428 Tel 541.752.4271 Fax 541.752.0276

July 23, 1997

City of McAllen

138067.A0.ZZ

Analytical Data for City of McAllen RE: CVO Laboratory Reference No. 5700

Jii Geisbush/PHX

On July 8.1997. the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Since&.

Ullufinace

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvallis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271 Fox No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
570001	Zeeweed Feedwater	07/07/1997	
570002	Zeeweed Permeate	07/07/1997	
570003	Memcor Filtrate	07/07/1997	

÷ 1

CH2M HILL Applied Science Laboratory Reference No. 5700

CASENARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5700

Client/Project: City of McAllen

- I. <u>Holding Time:</u> Au acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:
 - A. <u>Calibration</u>: An acceptance criteria were met.
 - Blanks: All acceptance criteria were met except for Total Phosporus which had a blank result of 0.06 mg/L.
 - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
 - D. <u>Duplicate Sample(s):</u> All acceptance criteria were met.
 - E. <u>Lab Control Sample(s)</u>: Lab control for Total Phosporus did not meet acceptance criteria. All other lab control acceptance criteria were met.
 - F. <u>Other</u>. Nut applicable.
- N. <u>Documentation Exceptions:</u> None:
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL. both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Helen Van Nice</u> Reviewed by: <u>Anav ins</u>

Client_Information Lab_Information Project Name: Cil of McAllen Pilot Study Date Rec2: 07/08/97 Sampled By: R. Villarreal Report Revision No: 0 Client Sample ID: Zeeweed Feedwater Report Revision No: 0 Sampling Date: 07/07/97 Reported By: HVN Sampling Date: 07/07/97 Reported By: HVN Sampling Ime:: Not provided Type: Grab Matrix: water Basis:: As received Analyte Limit Result Qualifier Units Methodi Analyzed Chemistry 0.01 0.02 rng/L EPA 353.2 7/8/97 N=NC3/NO2 0.01 0.02 rng/L EPA 353.2 7/8/97 P-Total Phosporus 0.25 3.58 rng/L EPA 365.1 7/18/97	Corvallis Applie	d Sciences	Labora	tory '		. .	
Analyte Limit Result Qualifier Units Methods Analyzed Chemistry N-NO3/NO2 0.01 0.02 mg/L EPA 353.2 7/8/97 TKN 2 70.9 mg/L EPA 351.4 7/14/97	Project Name Project Manage Sampled By Client Sample II Sampling Date Sampling lime Typ Matri	e: Cii of McAlle er: Rosie Villarrea 7: R. Villarrea 9: Zeeweed Fee 9: 07/07/97 9:: Not provided 9: Grab x: water	⊒í	dy	Date Rec'd: Lab ID: Revision No.: Reported By:	570001 0 H V Ni	
N-NO3/NO2 0.01 0.02 mg/L EPA 353.2 7/8/97 TKN 2 70.9 mg/L EPA 351.4 7/14/97	Analyte			Qualifier	Units	Methodz	
	N-NO3/NO2 TKN	2	70.9		mg/L	EPA 351.4	7/14/97

Applied Sciences Laboratory. 🐪 Corvallis Office 2300 NW Watnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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Corvallis Applied	Science	s Labora	atory			
Client Information Project Name: C Project Manager: I Sampled By: I Client Sample ID: Sampling Date: Sampling Time: Type: Matrix: Basis: J	Rosie Villarre R. Villarreal Zeeweed Pe 07/07/97 Not provided Grab	al	ły	b Information Date Rec'd Lab ID Revision No. Reported By Reviewed By:	: 07/08/97): 570002 : 0 (; HVN	
<u>A</u> nal e	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TK N P'-Total Phosporus TOC Color (ALPHA) Apparent	0.01 5 0.50 1.0 5	0.84 11.0 212 6.6 22		mg/L mg/L mg/L mg/L	EPA 3532 EPA 351.4 EPA 365.1 EPA 415.1 EPA 110.2	7/14/97 7/18/97 /2 7/11/97
U=Not detected at specifi	ed reporting l	imits				

Corvallis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 9733D-3538 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276 •••

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Corvallis Applied	Sciences	Labora	atory			
Project Manager: Sampled B Client Sample ID: Sampling Date: Sampling Time: Type: Matrix:	City of McAller Rosie Villarrea y: R. Villarreal Memcor Filtrat 07/07/97	j	y Report	b Information Date Rec'd: Lab ID: Revision No.: Reported By: Reviewed By:	07/08/97 570003 0 HVN	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed _
Chemistry TOC Color (ALPHA) Apparent		5.3 10		mg/L mg/L	EPA 415. EPA 110.2	1/2 7/11/97 7/8/97

Carvallis Office

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Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428

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ILKW Carviro Analylicel Laboratories, Inc.
 50 Batturst, Unit 12, Waterleo, Ontario, Canada N2V 2C5
 (519) 747-2575 FAX (519) 747-3606

1 ICVO 2300 NW Walnut Boulevaid Corvallis, OR 97330-3638 (541) 752-4271 FAX (541) 752 0276

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CH2M HILL 2300 NW Waknut Blvd. Corvaliis. OR 97330-3538 Mailing address: P.O. Box 428 Corvaliis. OR 97339-0428 Tel 541.752.4271 Fex 541.752.0275

July 17.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5664

Jim Geisbush/PHX

On July 1, 1997, the **CH2M** HILL **Corvallis** Applied Sciences Laboratory received three samples with a request for analysis of selected **parameters**.

The analytical results and associated quality **control** data are **enclosed**. Any **unusual difficulties** encountered **during** the analysis of your samples are discussed in the case **narrative**.

Under **CH2M HILL** policy, your samples **will** be stored for 30 days **after** reporting. If you have not given us prior **instructions** for **disposal**, we **will** contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences **Laboratory appreciates** your **business** and looks forward to saving **your** analytical needs again If you should have any questions concerning the data, **or** if you need **additional information**, please **call** Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Ullufner

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory . 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P. O. Box 428, Corvalis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276 . .

CASE NARRATIVE GENERALCHEMISTRY

Lab Reference No.: 5664

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Client/Project: City of McAllen

- L <u>Holding lime</u>: All acceptance criteria were ma
- IL <u>Digestion Exceptions</u>: None

III. Analysis:

- A. <u>Calibration:</u> All acceptance criteria were met.
- B. <u>Blanks</u>: AU acceptance criteria were met
- C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met
- F. <u>Other:</u> Nor applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Helen Van Nice</u> Reviewed by: <u>Singer Cottins</u>

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5664

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
566401	Zeeweed Feedwater	06/30/1997	10:42
566402	Zceweed Permeate	06/30/1997	10:42
566403	Memcor Filtrate	06/30/1997	10:42

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Client_Informatio	n		La	b Information		
Project Name	e: Cii of McAlle	n Pilot Stu	dy 🚽	Date Rec'd:		
	r: Rosie Villarre		-	Lab ID:	566401	
Sampled B	y: R. Villarreal		Repor	Revision No.:		
	D: Zeeweed Fee	dwater		Reported By:		
Sampling Date				Reviewed By:	gmc_	
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	e: Grab					
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<u>Anaiyte</u>	Limit	Result	Qualifier	Units	Method	Analyzed
Chamicter						
Chemistry N-NO3/NO2	0.01	0.05		mg/L	EPA 353.2	7/1/97
TKN	5.0	33.5		mg/L	EPA 351.4	
P-Total Phosporus	0.5	4.21		mg/L	EPA 365.1	
TOC	10.0	60.0		mg/L	EPA 415.1/2	7/11/97
•						
ć						
U=Not detected at spe	cified reporting !	imits				

Applied Sciences Laboratory - 2300 NW Walnut Blvd., Corvallis, OR 9733D-3538 Corvallis Office P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No. (541) 752-0276 :.

i.

Corvallis Applied	Sciences	s Labora	atory	ar name ann an an Anna an Anna Anna Anna Anna		
Project Manager sampled By: Client Sample ID: Sampling Date: Sampling lime: Type: Matrix:	Cii of McAlle Rosie Villarrea R. Villarreal Zeeweed Pen 06/30/97 10:42	al	dy	b Inf Date Rec'd: Lab ID: Revision No.: Reported By: Reviewed By:	566402 0 HVN	
Anatyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TKN P-Total Phosporus TOC Color (ALPHA) Apparent		0.01 20.0 0.34 7.0 15		mg/L mg/L mg/L mg/L	EPA 353.2 EPA 351.4 EPA 365.1 EPA 415.1 EPA 110.2	7/1 4/97 7/1/97

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(541) 752-4271 Fax No. (541) 752-0276 ~-

Corvallis Applied					, 1.	
Project Name:			dy		: 07/01/97): 566403	
Project Manager I Sampled By: I		ଥ	Report	Revision No.		
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Chemistry						
N-NO3/NO2	0.10	271		mg/L	EPA 353.2	7/1/97
	20 0.05	32 0.17		mg/L mg/L	EPA 351.4 EPA 366.1	7/14/97 7/1/97
P-Total Phosporus	1.0	0.1 7 6.1		mg/L	EPA 415.1/2	
Color (ALPHA) Apparent	5	13		mg/L	EPA 110.2	7/1/97
U=Not detected at specifi	ed reporting l	imits				<u></u>

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CH2M HILL 2300 NW Wainut Blvd Corvallis, OR 97330-3538 Mailing address: P.O. Box 428 Corvallis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0275

07/15/97

City of McAllen

CH2MHILL

Subject Acknowledgment of sample sot 5748.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on **7/15/97**. It has been assigned **laboratory** number 5748. Please refer to the laboratory **number** if you need to inquire about this sample **set**. I have attached a copy of the chain of custody form to provide additional **information**.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3 117.

7 🔔

Sincerely, CH2M HILL

Servi Marttak.

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Jerri Mattick

Attachment

Contraction of Custody Record AND AGREEMENT TO PERFORM SERVICES

LMO 2567 Faktane Drive Monigomery, Al. 36116-1622 (334) 271-1444 FAX (334) 271-3428

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 Canvice Analytical Laboratories, Inc.

 Redding, CA 8603
 1412
 50 Baihussi, Unit 12, Waterloo, Ontario, Canada N2V 2C5

 (916)
 244-5227
 FAX (618)
 244-4109

 (618)
 747-2675
 FAX (619)
 747-3806

Corvella, OR 97330-3838 (641) 752-4271 FAX (641) 752-0278

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CH2M HILL 2300 NW Wainut Blvd. Corvatis. OR 97330-3538 Mailing address: P.O. Box 428 Corvatilis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276 e

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7/9/97

City of McAllen

CH2MHILL

Subject: Acknowledgment of sample set 5700.

Dear Jii Geisbush/PHX:

This letter is m **acknowledge** the **receipt** of your sample set on **7/8/97**. It has been assigned laboramry number 5700. Please refer m the **laboratory** number if you need m **inquire about** this sample set I have attached a copy of the chain of cusmdy form m provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free m call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Jew Martick

Jerri Mattick

Attachment

CHI2MIHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

[] **LNG** 2567 Fakiane Drive Monigamery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

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CH2M HILL 2300 NW Wainut Blvo. Corvafis. OR 97330-3538 Mailing address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.4271 Fex 541.752.0275

July 4, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5597

Jim Geisbush/PHX

On June 23, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical **results and** associated **quality control** data **are** enclosed. Any **unusual difficulties** encountered during **the** analysis of your samples are discussed in **the** case **narrative**.

Under CH2M HILL policy, you samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory **appreciates** your business and looks forward to serving **your** analytical needs again. If you should have any questions concerning the **data**, or if you need **additional information**, please call Ms. Kathy McKinley at (541) **758**-0235, extension 3120.

Sincerely,

allerance

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Carvallis, OR 97330-3538 Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

CLIENT SAMPLE CROSS-REFERENCE

CVO Sample ID	client Sample ID	Date Collected	Time collected
559701	Zeeweed Feedwater	06/20/1997	8:23
559702	Zeeweed Permeate	06/20/1997	8:23
559703	Memcor Filtrate	06/20/1997	8:23

CH2M HILL Applied Science Laboratory Reference No. 5597

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CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5597

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Client/Project: City of McAllen

- I. <u>Holding Time:</u> Holding time for color was exceeded when the sample was received. All other acceptance criteria were met
- II. Digestion Exceptions: None

III. <u>Analysis</u>:

- A. <u>Calibration</u>: All acceptance criteria were met
- B. <u>Blanks</u>: An acceptance criteria were met.
- C. <u>Matrix Spike Sample(s)</u>: Matrix spike for **TKN** was lost due to sample dilution. All other matrix spike acceptance criteria were **met**.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met except for TKN.
- F. <u>Other</u>. Not applicable.
- N. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Reviewed by: <u>Ainer Collins</u> Prepared by:

Project Manage Sampled B Client Sample I sampling Dat Sampling Time Type Matrix	n e: City of McAlle r: Rosie Villarre y: R. Villarreal): Zeeweed Fee e: 06/20/97	n Pilot Study al	Lab Report I	Information Date Rec'o Lab ID Revision No. Reported By Reviewed By	l: 06/23/97 : 559701 : 0 /: HVN	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TKN P-Total Phosporus	ʻ0.01 4 0.50	0.58 28.8 4.76		mg/L mg/L mg/L	EPA 3532 EPA 351.4 EPA 365.1	
؛ U=Not detected at spec	cified reporting lin	mits				

Applied Sciences Laboratory Corvallis Office

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2300 NW Walnut Blvd., Carvallis, OR 97330-3538 P.O. Box 428, Corvatlis, OR 97339-0428 (541) 752-4271 Fax Nc.(541) 752-0276

Corvallis Applied Sciences Laboratory

<u>Client Information</u> Project Name: City of McAllen Pilot Study Project Manager: Rosie Villarreal Sampled By: R Villarreal Client Sample III: Zeeweed Permeate Sampling Date: 06/20/97 Sampling lime: 823 Type: Grab Matrix: water Rasis: As received			Lab Information Date Rec'd: 06/23/97 Lab ID: 559702 Report Revision No.: 0 Reported By: HVN Reviewed By:			
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TKN P-Total Phosporus	0.10 4 0.05	132 4 0.55	ue U	mg/L mg/L mg/L	EPA 3532 EPA351.4 EPA 365.1	6/27/97 6/30/97 7/1/97

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Applied Sciences Laboratory

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2300 NW Wainut Blvd., Corvatiis, OR 97330-3538 P.O. Box 428, Corvatiis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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Client Information Project Name: City of McAllen Project Manager: Rosie Villarreal Sampled By: R. Villarreal Sampling Date: 6/20/97 Sampling Time: 823 Type: Grab Matrix: water Basis: As received			Lab Information Laboratory ID: ICROR001 Date Rec'd: 6/23/97 Analytical Method: EPA 1102 Date Analyzed: 6/24/97 Report Revision No.: 0 Reported By: HVN Reviewed By: Gmc		
Client Sample ID	Lab Sample ID	Reporting Limit	color (ALPHA) Apparent Result	Units	
Memcor Filtrate	559703	5	20	Color Units	

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-Applied Sciences Laboratory Corvallis Office

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2300 NW Walnut Blvd., Corvatiis, OR 97330-3538 P.O. Box 428, Corvatiis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

Project Manage Sampled By Sampling Date Sampling Time Type Matrix			Lab Information Laboratory ID: ICROR001 Date Rec'd: 6/23/97 Analytical Method: SM5310.D Date Analyzed: 6/25/97 Report Revision No.: 0 Reported By: G. Collins Reviewed By					
Cilent Sample ID	Lab Sample ID	pН	Reporting Limit	Replicate 1	TOC Water Replicate	2 Avenge	Percent RPD	
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Applied Sciences Laboratory Corvallis Office

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2300 NW Watnut Blvd., Carvallis, OR 97330-3538 P.O. Bax 428, Carvallis, OR 97339-0428

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[541] 752-4271 Fax No.[541] 752-0276

CH2MI-IILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

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† 11.MG: 2567 Faktane Ditve Montgomery, AL: 36116: 1622 (334) 271-1444 - FAX (334) 271-3428

 I ILRD 5090 Caterpillar Road
 I ILNW Canvico Analytical Laboratories, Inc.
 I ICV0 2300 NW Walnut Boulevard

 Redding, CA 96003 1412
 50 Bathurst, Unit 12, Waterloo, Ontailo, Canada N2V 205
 Corvaits, OR 97330 3838

 (916) 244-5227
 FAX (916) 244-4109
 (519) 747-2575
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 (541) 752 4271

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MONTHLY BILLING SUMMARY

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Applied Sciences Laboratory

CH2MHILL Corvailis, Oregon 2300 NW Walnut Blvd, Corvallis, OR 97330-3538 P.O. Box 428. Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

Cii of McAllen

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Project Manager: Jim Geisbush/PHX

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Invoice Date 06/23/97 Invoice No. A97-1165

Page 1 of 1

-	ustomer Number 138067.A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Pe 7/9/9		erence: No. 5597
Qty	Description		Trans. Date	Unit Cost	Subtotal
1	Color (ALPHA) Apparent	6/23/97	\$20.00	\$20.00	
2	Nitrate/Nitrite		6/23/97	\$35.00	\$70.00
2	Total Phosphorus	1	6/23/97	\$25.00	\$50.00
2	Total Kjeldahl Nitrogen		6/23/97	\$35.00	\$70.00
1	Total Organic Carbon		6/23/97	\$40.00	\$40.00
	(THIS IS NOT A BILL -	DO NOT SUBMIT PAYMENT) TOTAL	AMOUNT:	\$250.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -



CH2M HILL 2300 NW Wainut Sivit Corvalis, OR 97330-3538 Mailing address: P.O. Box 428 Corvalis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

July 3, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5607

Jim Geisbush/PHX

On June 24.1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M** I-ILL **Applied** Sciences **Laboratory** appreciates your business and looks forward to **serving your analytical** needs again. If you should have any **questions** concerning **the** data, or **if** you **need** additional information, please **call Ms.** Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Munner

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory. 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 Corvalis Office P. O. Bax 428, Corvalis, OR 97339-0428 541 752-4271 Fox No. 541 752.0276

APP-76

CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5607

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
56070 1	Zeeweed Feedwater	06/23/1997	10:40
560702	Zeeweed Permeate	06/23/1 997	10:40
560703	Memcor Filtrate	06/23/1997	10:40

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CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5607

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Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions:</u> None

III. <u>Analysis</u>:

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- A. <u>Calibration</u>: All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
 - C. <u>Matrix Spike Sample(s)</u>: Matrix spike for TKN was lost due to sample dilution. All other matrix spike acceptance criteria were met.
 - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
 - <u>Lab Control Sample(s)</u>: All acceptance criteria were met except for TKN.
 - F. <u>Other</u>. Not applicable.
- Iv. <u>Documentation Exceptions:</u> None.

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Allen Van Nece</u> Reviewed by: <u>Amaje Collins</u>

Cline Cite Cite of McAllen Pilot Study Project Name: Cit of McAllen Pilot Study Project Manager: Rosie Villarreal sampled By: R. Villarreal Client Sample ID: Zeeweed Feedwater Sampling Date: 06/23/97 Sampling Time: 10:40 Type: Grab Matrix: Water Basis: As received										
Analyte	Reporting Limit	Sample Result	Oualifier	Units	Method	Date Apabized				
Chemistry N-NO3/NO2 TIKN P-Total Phosporus TOC	0.10 2 0.05 0.5			-	EPA 351.4 EPA 365.1	6/30/97 7/2/97				

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 P.O. Box 428, Corvalis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276 2.

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Client Information Project Name: Project Manager: Sampled By:	Rosie Villarrea		У	b Information Date Rec'd: Lab IO t Revision No.:	0 6/23/97 560702					
Client sample IO: Zeeweed Permeate Reported By: HVN Sampling Date: 06/23/97 Reviewed By: gmc Sampling Time: 10:40 Sampling Time: 10:40										
Type:					•					
Matrix:										
Basis:	As received									
	Reporting	Sample				Dat				
Analyte	limit	Result	Qualifier	Units	Method	Analy				
Chemistry										
N-NO3/NO2	0.01	1.01		mg/L	EPA 353.2	6/27				
TKN	2	5.1		mg/L						
P-Total Phosporus	0.05	0.35		mg/L		-				
TOC	0.5	6.6		mg/L	EPA 415.1/2					
Color (ALPHA) Apparent	5	10		mg/L						
U=Not detected at specifi		lim	it	_						

Applied Sciences Laboratory , 1. Corvalis Office

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2300 N W Wainut Bivd., Corvailis, 0 R 97330-3538 P.O. Box 428, Corvailis, 0 R 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

Client Information Project Name: Project Manager: Sampled By: Client Sample ID: Sampling Date: Sampling lime: Type: Matrix: Basis:	Rosie Villarrea R. Villarrea Memcor Filtra 06/23/97 10:40 Grab	al	Report F		o.: 0 y: I	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyz
Chemistry N-NO3/NO2 TKN P-Total Phosporus TOC Color (ALPHA) Apparent	0.01 4 0.50 10.0 5	0 . 4 59.0 3.89 56.8 20	1 	mg/L mg/L mg/L mg/L	E P A 33 EPA 351.4 EPA 365.1 EPA 415.7 EPA 1102	6/30/9 7/2/9 112 6/27/9
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Applied Sciences Laboratory2300 NW Watnut Blvd., Corvalis, OR 97330-3538Corvalis OfficeP.O. Box 428, Corvalis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

1 - LNG 2567 Feklane Drive Monigomery, AL 36416 - 1622 (334) 271-1444 - FAX (334) 271-3428

I ILRB 6090 CaterpHar Road I ILRW Canviro Analytical Laboratories, Inc. Redding, CA 96003-1412 60 Bathurel, Unit 12, Waterloo, Ontario, Cauada N2V 2C6 (910) 244 5227 FAX (916) 244-4109 (519) 747-2575 FAX (519) 747-3806

1 ICVO 2300 NW Walnut Boulevard Corvalis, OR 97330 3638 (541) 762 4271 FAX (541) 752 0276

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CH2M HBLL 2300 NW Walnut Blvd, Corvatis, OR 97330-3538 Mailing accress: P.O. Box 428 Corvatis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

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CH2MHILL

Scptenk5. 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of **McAllen** CVO Laboratory Reference No. 5607

Jii Lozier/PHX

On June 24, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

An error was found on your original report due to a log in mor. The TOC bottles for the Zeeweed Feedwater and Memcor Filtrate were labeled incorrectly. please replace your original report pages with the attached revised results for Zeeweed Feedwater and Memcor Filtrate.

The **CH2M** HILL Applied Sciences Laboratory **appreciates** your business and looks forward to **serving** your **analytical** needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Linger Collins

Ginger Collins Environmental Chemist

Enclosures

Client Information Lab Information Project Name: City of McAllen Pilot Study Date Rec'd: 06/24/97 Project Manager: Rosie Villarreal Lab ID: 560701 Sampled By: R. Villarreal Report Revision No.: 1 Client Sample ID: Zeeweed Feedwater Reported By: HVN Sampling Date: 06/23/97 Reviewed By: Grack sampling Time: 10:40 Type: Grab Matrix: Water Basis: As received Reporting Sample Date										
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed				
Chemistry N-NO3/NO2 TKN P-Total Phosporus TOC	0.10 2 0.05 10.0	2.94 2 0.12 56.6	u	mg/L mg/L mg/L	EPA 353.2 EPA 351.4 EPA 365.1 EPA 415.112	6/27/97 6/30/97 7/2/97 6/27/97				

Applied Sciences Laboratory

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(541) 752-4271 Fax No.(541) 752-0276

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Project Manager I Sampled By: I Client Sample II Sampling Date: Sampling Time: Type: Matrix:	R. Villarreai D: M-r Fittrate 06/23/97 10:40 Grab		у	b Information Date Rec'd: Lab ID: t Revision No.: Reported By: Reviewed By:	06/23/97 560703 1 HVN	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyze
Chemistry N-NO3/NO2 TKN P-Total Phosporus TD C Color (ALPHA) Apparent	0.01 4 0.50 0.5 5	0.41 59.0 3.89 6.1 20		mg/L mg/L mg/L mg/L	EPA 353.2 EPA 351.4 EPA 365.1 EPA 415.1/ EPA 110.2	4 6/30/97 7/2/97
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Applied Sciences Laboratory

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276 Ξ.

MONTHLY BILLING SUMMARY

CH2IVIHILL Applied Sciences Laboratory Corvallis, Oregon 2300 NW Wainut Blvd, Convallis, OR 97330-3538 P.O.Box 428, Convallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Project Manager: Jim Geisbush/PHX

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Invoice Date 06/24/97 Invoice No. A97-1178

Page 1 of 1

CH2M Hill Rep. Billing Period Customer Number Reference No. 7/9/97 138067.A0.ZZ Ginger Collins 6607 Qty Description Trans. Date Unit Cost Subtotal 3 Color (ALPHA) Apparent 6/24/97 \$20.00 \$60.00 6/24/97 635.00 \$105.00 Nitrate/Nitrite 3 3 Total Phosphorus Total Kjeldahl Nitrogen 6/24/97 \$25.00 \$75.00 3 6/24/97 \$35.00 \$1 (15.00 3 Total 6/24/97 \$40.00 Organic Carbon \$120.00 \$465.00 (THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT:

Our records indicate **that** the above tests were requested during the current billing period. Please notify the laboratory listed above if mere are any discrepancies.

- PROJECT COPY -



CH2M HILL 2300 NW Watnut Blvc. Corvalis. OR 97330-3538 Mailing address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

д.

7/2/97

City of McAllen

Subject Acknowledgment of sample set 5664.

Dear Jim Geisbush/PHX:

This letter is m acknowledge the receipt of your sample set on 7/1/97. It has been assigned laboratory number 5664. Please refer to the laboratory number if you need m inquire about this sample set I have attached a copy of the chain of custody form m provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free m call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Ven Martick

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Jerri Mattick Attachment

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- RECEIVED -,1111 7 1997 CH2m HILL/ProJENIX CH2MHIEL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LNG 2567 Fairlane Drive
 Monigomery, AL 36115-1622
 (334) 271-1444 FAX (334) 271-3428

 LR0
 6090 Cliferpiliar Road
 LNW Canviro Analytical Laboratorias, Inc.

 Redding, CA 96003-1412
 50 Balturat, Unit 12, Walerloo, Ontario, Canada N2V 2C5

 (916) 244-5227
 FAX (910) 244-4109

Cavalis, OR 97330-3638 (541) 752-4271 FAX (541) 75, -4278

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CH2M HILL 2300 NW Walnut Blvd. Corvallis, OR 97330-3538 Mailing address: P.O. Box 428 Convallis: OB 97339-0428 Tel 541.752.4271 Fax 541.752.0276

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July 30, 1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5748

Jim Geisbush/PHX

On July 15, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are. discussed in the case narrative.

Under **CH2M** HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M** HILL Applied Sciences **Laboratory** appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Mufner

Kelly Ensor Senior Administrative Assistant

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Enclosures

Corvallis Office

Applied Sciences Laboratory 2300 NW Watnut Bivd., Corvalis, OR 97330-3538 P. O. 8ax 428, Corvatilis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

# CLIENT SAMPLE CROSS-REFERENCE

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CH2M HILL Applied Science Laboratory Reference No. 5748

CVO Sample ID	<b>Client Sample ID</b>	Date Collected	Time Collected
574801	Zeeweed Feedwater	07/14/1997	9:45
574802	Zeeweed Permeate	07/14/1997	9:45
574803	Memcor Filtrate	07/14/1997	9:45

## CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5748

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## Client/Project: City of McAllen

- I. <u>Holding The:</u> An acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - B. <u>Blanks</u>: Blank for Total Phosphate had 0.06 mg/L PO.-P. Other acceptance criteria were met.
  - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: Lab Control for Total Phosphate did nor meet criteria. Other acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- Iv. Documentation Exceptions: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Kelen Van Nie Reviewed by: <u>Singer Collins</u>

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Project Mana Sampled Client Sample Sampling D Sampling Ti Ty Ma	me: City of McAlla ger: Rosie Villarre By: R. Villarreal ID: Zeeweed Fee Date: 07/14/97 me: 9:45 /pe: Grab trix: Water isk.: As received	al	Report	Date Rec'd:	574801 0 HVN	
Analyte	Reporting <b>Limit</b>	Sample <b>Result</b>	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TKN P-Total Phosporus TOC	0.10 5.0 <b>0.25</b> 10.0	0.10 612 1.67 46.5	U	mg/L mg/L mg/L	EPA 363.2 EPA 361.4 EPA 366.1 EPA 415.1/	7/17/97 7/18/97
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Applied Sciences Laboratory

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Bax 428, Corvallis, OR 97339-0428

Sampling lime: 9: Type: 0 Matrix: W Basis: A	Grab			Revision No. Reported By: Reviewed By		
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Chemistry N-NO3/NO2 TKN P-Total Phosporus TOC Color (ALPHA) Apparent	0.10 1.0 0.05 1.0 5	0.10 12.5 0.05 9.7 10	U U	mg/L mg/L mg/L mg/L	EPA 353.2 EPA 351.4 EPA 365.1 EPA <b>415.1/2</b> EPA 110.2	7/16/97 7/18/97 7/18/97 7/24/97 7/15/97

Applied Sciences Laboratory

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0429 

Corvailis Applied	Sciences	s Labora	atory				
Project Manager: Sampled By: Client Sample ID: Sampling Date: Sampling lime: Type: Matrix:	R. Villarreal Memcor Filtra 07/14/97 9:45 Grab	li	dy	Dinformation Date R&d: Lab ID: Revision No.: Reported By: Reviewed By:	67460 0 HVN	3	
Analyte	Reporting <b>Limit</b>	Sample Result	Qualifier	Units	Met	thod	Date Analyzed
Chemistry N-NO3/NO2 Tikn P-Total Phosporus TOC Color (ALPHA) Apparent	0.10 1.0 0.05 1.0 5	3.46 1.9 0.05 6.7 5	U U	mg/L mg/L mg/L mg/L	EPA EPA EPA	366.1	7/16/97 7/17/97 7/18/97 2 7/24/97 7/15/97

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Applied Sciences Laboratory Corvallis Office

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2300 NW Wainut Blvd., Corvallis, OR 97330-3538 P.O. Bax 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276 e*--

Hir-Inc

# CH2MHILL Analylical Services CHAIN OF CUSTOPY RECORD AND AGREEMENT TO PERFORM SERVICES

I. ILMÖ. 2587 Faklana Driva Montgomery, AL 36116-1622 (334) 271-1444 - FAX (334) 271-3428

 I ILRD 6090 Celerpiter Road
 I ILKW Cenviro Analytical Laboratories, Inc.
 I ICV0 2300 NW Walnut Boulevard Redding, CA 96003-1412
 60 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 205
 Corvalis, OR 97330 3638

 (916) 244-5227
 FAX (916) 244-4109
 (619) 747-2575
 FAX (519) 747-3806
 (541) 752-0276

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CH2M HILL
 2300 NW Walnut Bive.
 Corvatis, OFI
 97330-3538
 Mailing address:
 P.O. Box 428
 Corvatilis. OR
 97339-0428
 Tel 541,752,4271
 Fex \$41,752,0276

08/05/97

City of McAllen Pilot Study

Subject: Acknowledgment of sample set 5875.

Dear Jim Lozier/PHX:

This letter is to acknowledge the receipt of your sample set on 8/5/97. It has been assigned laboratory number 5875. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of tie chain of custody form to provide additional information.

There were no problem noted with the receipt of your samples

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Jew Martick

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- RECEIVED 2.4 AUG 6 8 19--GHZLE HILL/FAC.

Jerri Mattick

Attachment

# CHI2MIHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LNG 2567 Fairlane Drive Muniquaries, AL 36110-1022 (334) 271-1444 FAX (334) 271-3428

LRD 6090 Celerpiller Roed Redding, CA 96903-1412 (918) 244-5227 FAX (918) 244-4109

[.]LKW Cenvico Analylical Laborstovies, inc. 50 Belturist, Unit 12, Weterboy, Onterio, Cenada N2V 205 (519) 747-2575 FAX (519) 747-3906

· 💻 / Corvalue, OR 97330-3638 (541) 762-4271 FAX (541) 752-0278

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- R=FEIVED --CH2M HELL AUE 1 1 1997 2300 NW Wanut Bivd. Corvalis. OR 97330-3538 Mailing address: PO. Box 428 Corvalis. OR 97335-0428 Tel 541.752.4271 Fex 541.752.0276

8/5/97

City of McAllen pilot Study

subject Acknowledgment of sample set 5872.

Dear Iii Lozier/PHX:

This letter is to acknowledge the receipt of your sample set on 8/4/97. It has been assigned laboratory number 5872. Please refer to the laboratory number if you need to inquire about this sample set. I have anached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

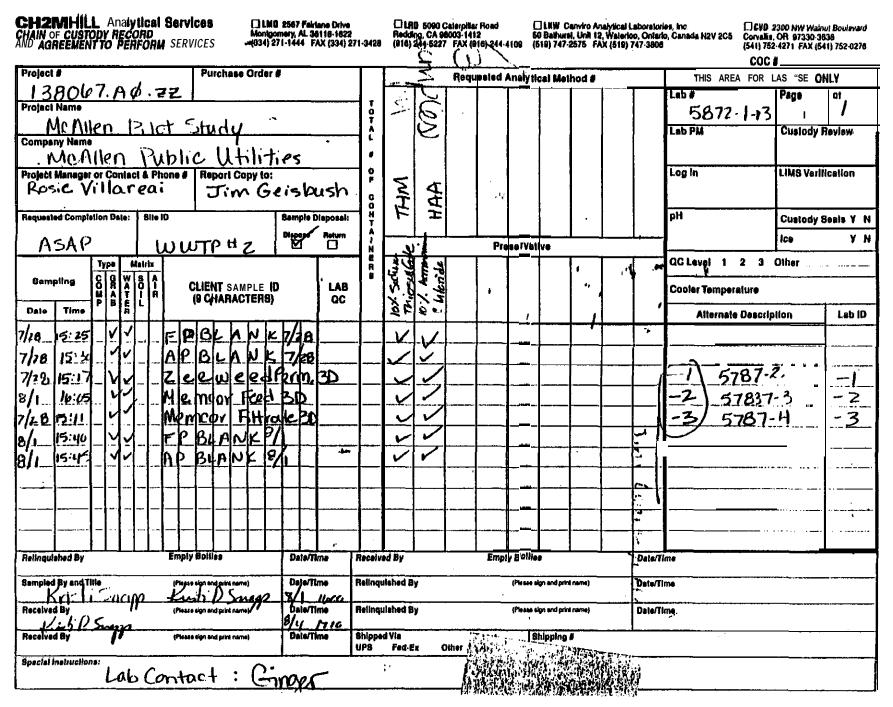
If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Jewi Martick

Jerri Mattick

Attachment



APP-99



to, to 4 - 4 Ĉ,

CH2M HBLL 2300 NW Walnut Blvd. Corvaliis. OR 97330-3538 Mailing address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.0276

08/13/97

City of McAllen

Subject: Acknowledgment of sample set 5916.

Dear Jim Lozier/PHX:

This letter is to acknowledge me receipt of your sample set on 8/12/97. It has been assigned laboratory number 5916. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Jewi Mactak

Jerri Mattick

Attachment

CH2IMHIL Analylical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

1 LMG 2567 Fakiana Drive Montgomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

 ILRU 5090 Ódiantitar Road
 ILRW Canviro Analytical Laboratories, Inc.
 ILCVO 2300 NW Walnul Boulevard Corvalis, OR 9730 3838

 Redding, CA 96003-1412
 50 Bathwet, Unit 12, Waterloo, Ontario, Canada N2V 205
 Corvalis, OR 9730 3838

 (916) 244-5227
 FAX (916) 244-4109
 (519) 747-2575
 FAX (519) 747-3806
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DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client HEV 1/97 LAB FORM 340

CH2M HILL 2300 NW Wahut Bivd. Corvalits, OR 97330-3538 Mailing address: P.O. Box 428 Corvalits, OR 97339-0428 Tel 541,752,4271 Fax 541,752,0278



August 15.1997

City of McAllen Pilot Study

138067.A8.ZZ

RE: Analytical Data for City of McAllen Pilot Study CVO Laboratory Reference No. 5787 & 5872

Jim Lozier/PHX

On July 22, and August 4, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received seven samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and look forward to serving your analytical needs again If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Wingnoor

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory Corvalis Office 2300 NW Walnut Blvd., Corvatis, OR 97330-3538 P. 0. Bax 428, Corvatis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

# CLIENT SAMPLE CROSS-REFERENCE ...

CVO Sample ID	Client Sample <b>ID</b>	Date Collected	Time Collected
578701	Zeeweed Feedwater	7/21/97	11:15
578702	Zeeweed Permeate	7/21/97	11:15
578703	Memcor <b>Feedwater</b>	7/21/97	11:15
578704	Memcor Filtrate	7/21/97	11:15
587201	Zeeweed Perm 3D	7/28/97	15:17
587202	Memcor Feed 3D	8/01/97	16:05
587203	Memcor Filtrate 3D	7/28/97	15:11

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# CH2M HILL Applied Science Laboratory Reference No. 5787 & 5872

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# CASE NARRATIVE DBPs/ORGANICS

Lab Reference No.: 5872

## Client/Project: City of McAllen Pilot Study

- L <u>Holding Times</u>: All acceptance criteria were met.
- II. Analysis:

- A. <u>Calibration:</u> All acceptance criteria were met.
- B. <u>Blanks:</u> All acceptance criteria were met.
- C. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- D. <u>Spike Sample(s)</u>: Dichloroacetic acid recovery (132%) exceeded acceptance criteria. All other acceptance criteria were met.
- E. <u>Surrogate Recoveries:</u> All acceptance criteria were met.
- F. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
- G. Other:

-

- Internal standard recoveries for samples 587202 & -03, 175% and 179% respectively, did not meet acceptance criteria.
- III. <u>Documentation Exceptions</u>: None
- IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

ingen Collins 8/15/97 Prepared by: . Reviewed by: 🗠

## CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5787

Client/Project: City of McAllen Pilot Study

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:
  - A <u>Calibration:</u> All acceptance criteria were met.
  - B. <u>Blanks</u>: All acceptance criteria were met.
  - c. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signamre.

ŗ Prepared by: <u>Aclen Van Vlie</u> Reviewed by: <u>Minger</u> Coffins

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# CASE NARRATIVE DBP/FORMATION POTENTIAL

Lab Reference No.: 5787

Client/Project: City of McAllen Pilot Study

I. <u>Holding Time:</u> All holding times were met.

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- II. pH / Cl residual analysis:
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - Blanks: FP blank from 7/25/97 contained TTHM of 9.5 µg/L. AP blank from 7/25/97 recovered 129% TTHM. Acceptance criteria for FP and AP blanks from 7/29/97. were met.
  - C. <u>Other</u>. None
- IV. <u>Documentation Exceptions</u>: None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

John A. Thank Prepared by: Reviewed by:

Corvallis Applie	d Sciences	s Labora	atory							
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Client Information Lab Information										
Project Name: City of McAllen Pilot Study Date Rec'd: 07/22/97										
Project Manager: Rosie Villarreal Lab ID: 578701										
sampled By: Enrique Perez Report Revision No.: 0 Client Sample ID: Zeeweed Feedwater Reported By: HVN										
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N-NO3/NO2	0.1	0.1	U	mg/L	EPA 253.2	7/25/97				
TKN	- 5	101		mg/L	EPA 351.4	7/25/97				
P-Total Phosphorous	0.5	13.5		mg/L	EPA 365.1	8/12/97				
N-Ammonia	1.0	302		mg/L	SM4500-NH3-D	7/25/97				
1										
U=Not detected at spec	ified reporting (i	inits								

Applied Sciences Laboratory2300 NW Walnut Blvd., Corvallis, OR 97330-3538Corvallis OfficeP.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

#### Corvallis Applied Sciences Laboratory **Client Information** Lab information . ... Project Name: City of McAllen Pilot Study Date Rec'd: 07/22/97 Project Manager: Rosie Villarreal Lab ID: 578702 Sampled By: Enrique Perez Report Revision No.: 0 Client Sample ID: Zeeweed Permeate Reported By: HVN Reviewed By: gme Sampling Date: 07/21/97 Sampling Time: 11:15 Type: Grab Matrix: water Basis: As received Reporting **6**----i-

Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
0.1	16.1		mg/L	EPA 3532	7/25/97
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0.05	3.1		mg/L	EPA 365.1	8/12/97
1.0	8.0		mg/L	EPA415112	7/24/97
5	20		mg/L	EPA 1102	7/23/97
0.1	5.4		mg/L	SM4500-NH3-D	7/25/97
	0.1 1 0.05 1.0 5	Limit         Result           0.1         16.1           1         8.7           0.05         3.1           1.0         8.0           5         20	Limit Result Qualifier 0.1 16.1 1 8.7 0.05 3.1 1.0 8.0 5 20	Limit         Result         Qualifier         Units           0.1         16.1         mg/L           1         8.7         mg/L           0.05         3.1         mg/L           1.0         8.0         mg/L           5         20         mg/L	Limit         Result         Qualifier         Units         Method           0.1         16.1         mg/L         EPA 3532           1         8.7         mg/L         EPA 351.4           0.05         3.1         mg/L         EPA 365.1           1.0         8.0         mg/L         EPA 415112           5         20         mg/L         EPA 1102

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Applied Sciences Laboratory Corvalis Office 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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			City of McAller	n Pilot study			1: 07/22/97	
Pt			Rosie Villarrea			Lab II	D: 676704	
	San	npled By:	Enrique Perez		Report			
			Memcor Filtrat	;e		Reported By	y: HVN	
			07/21/97			Reviewed By	: gmc	
Ś	Sampli	ng Time:					0	
		Type:						
		Matrix:						
		Dask:	As received					
			Reporting	Sample				Date
Analyte			Limit	Result	Qualifier	Unite	Method	
Chemisti TOC	У		1.0	6.2		mg/L		7104107
		Annorom		6.2 5		-	EPA 415.1/2 EPA1102	
Color (Al	_PHA)	Apparent	5	5		mg/L	EPATIOZ	//23/9/
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 Applied Sciences Laboratory
 2300 NW Walnut Blvd., Carvallis, OR 97330-3538

 Corvallis Office
 P.O. Box 428, Corvallis, OR 97339-0428

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(541) 752-4271 Fax No.(541) 752-0276

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				ab Inf	
Project Nam	ne: City of McAllen			Date Rec'd: 7	
	er: Rosie Villarreal			Lab ID: 5	
	y: Enrique Perez			Analysis Method: S	
	D: Zeeweed Permea	ite	Rep	ort Revision No.: C	
Sampling Dat				Reported By: I	DAH
Sampling lin				Reviewed By:	KAS
	be: Grab				-
	rix: Water				
Bas	is: As Received				
A/THM Formation P	Potential Test Conditi	ons		• • •	<b></b>
	Termet		Contact	Contact	Chiorir
Set-up Date/Time	Target Contact Time	nitial pH	pH	Temperature (°C)	Dosag (mg/L
Daterintie	Contact Tane		<u>pr 1</u>	<u>()</u>	(mgn
7/25/97 15:46	72:00	7.6	7.9	23	10.00
orine Demand Test	Results				
<b>.</b>				Measured	Chlorit
			Measured	Temperature	Residu
Take-off	<b>. .</b>				
Take-off Date/Time	Contact Time		pH	(°C)	<u>(mg/L</u>
	Contact Time 71:31				<u>(mg/L</u> 2.18
Date/Time			рН	(°C)	
Date/Time			рН	(°C)	
Date/Time			рН	(°C)	
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Date/Time			рН	(°C)	<u>(mg/L)</u> 2.18
Date/Time	71:31		рН	(°C)	
Date/Time			рН	(°C)	
Date/Time	71:31		рН	(°C)	

U=Not detected at specified reporting limits

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Project Manag Sampled B Client Sample II Sampling Dat Sampling Tim Typ Matri	e: City of McAllen sr: Rosie Villarreal y: Enrique Perez ): Memcor Feedwatt e: 7/21/97	Lab Information Date Rec'd: 7/22/97 Lab ID: 578703 Analysis Method: SM 5710.D Report Revision No.: 0 Reported By: DAH Reviewed By: LDS				
AA/THM Formation I Set-up Date/Time	Potential Test Conditi Target Contact lime	ons Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)	
7/29/97 15:29	72:00	7.3	7.9	23	7.10	
hlorine Demand Test Take-off Date/Time	Results Contact Time	Measured pH	Measured chlorine Temperature Residua (°C) (mg/L)			
8/1/97 16:05	72:36		7.0	23	1.03	
		. –				

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## Corvallis Applied Sciences Laboratory

Cline International City of McAllen Project Name: City of McAllen Project Manager: Rosie Villarreal Sampled By: Enrique Perez Client Sample ID: Memcor Filtrate Sampling Date: 7/21/97 Sampling Time: 11:15 Type: Grab	Lab Information Date Rec'd: 7/22/97 Lab ID: 578704 Analysis Method: SM 5710.0 Report Revision No.: 0 Reported By: OAH Reviewed By: GOS
1 0	

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HAA/THM Formation Potential Test Conditions

Set-up Date/Time	Target Contact Time	Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
7/25/97 15:52	72:00	7.3	7.8	23	9.00

Chlorine Demand Test Results

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Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)	
7/28/97 15:11	71:19	7.9	23	0.23	

U=Not detected at specified reporting limits

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Client tof Project Name: Project Manager: Sampled By: Client Sample ID: Sampling Dam: Sampling Time: Type: Matrix: Basis:	Rosie Villarreal Kristi Snapp Zeeweed Perm3 7/28/97 15:17 Grab	Lab Information Date Rec'd: 8/4/97 Lab ID: 587201 Report Revision No.: 0 Reported By: DAH Reviewed By: gmc Units: µg/L			
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyze
Haloacetic Adds • SM 6251.					
Chloroacetic acid	<i>7</i> 9-11-8	1.0	1.7		8/7/97
Bromoacetic acid	79-08-3	05	2.2		
-					en197
Dichioroacetic acid	79-43-6 76 00 0	05	215		8/7/97
Trichioroacetic acid	76-03-9	OR	4.4		8/7/97
Bromochloroacetic acid	5589-96-3	05	135		8/7/97
Dibromoacetic acid	631-64-l	05	13.4		8/7/97
2.3-Dibromopropanoic acid	600-05-5		130%	SS	
Trihalomethanes • EPA 502.	2				
Chloroform	67-66-3	05	42		8/11/97
Bromodichloromethane	75-27-4				•
Dibromochioromethane	124-43-l	05	65		8/11/97
	124-43-1 <b>75-25-2</b>	05	5.8		8/11/97
gromoform	10-20-2	05	5.4		8/11/97
1,2-Dichloroethane-d4	17068-07-0		66%	SS	
		· <b></b>			
E=Exceeded instrument calit	nation range				

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Project Manager: Sampled By Client Sampte ID: Sampling Date: Sampling Time: Type: Matrix:	Kristi Snapp Memcor Feed3 8/1/97 16:05 Grab	Lab Information Date Rec'd: 8/4/97 Lab ID: 587202 Report Revision No.: 0 Reported By: DAH Reviewed By: Opporte- Units: µg/L				
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date <b>Anaiyzeo</b>	
Haloacetic Acids - SM 6251	8					
Chloroacetic acid	7911-a	1.0	9.3		8/7/97	
Bromoacetic acid	79-08-3	0.5	4.2		8/7/97	
Dichloroacetic acid	79-43-6	0.5	35.3		8/7/97	
Trichlorpacetic acid	78-03-Q	0.5	35.2		8/7/97	
Bromochloroacetic acid	5589-96-3	0.5	23.8		8/7/97	
Dibromoacetic acid	631-64-I	0.5	11.6		8/7/97	
2,3-Dibromopropanoic acid	600-05-5		113%	SS		
Trihalomethanes • EPA 502	2					
Chioroform	67-66-3	05	136	Е	8/11/97	
Bromodichloromethane	75-27-4	0.5	101		8/11/97	
Dibromochloromethane	124-48-1	0.5	71.1		8/11/97	
Bromoform	75-25-2	0.5	9.0		8/11/97	
1,2-Dichloroethane-d4	1 <b>7068-07-</b> 0		88%	SS		
E=Exceeded instrument cali						

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Client Information Project Name: C Project Manager: I Sampled By: Client Sample IO: N Sampling Date: 7	Rosie Villarreal Kristi Snapp Iemcor Filtrate	3D	Lab Information Date Reed: 8/4/97 Lab ID: 567203 Report Revision No.: 0 Reported By: DAH Reviewed By: Gme					
Sampling lime: 1 Type: 0 Matrix: 1	1 <b>5:1</b> t Grab	Units: µg/L						
<u>Analyte</u>	CAS #	Reporting Limit	Sample Result	Qualifier	Date	Analyz	ed	
Haloacetic Acids - SM 6251.	-							
Chloroacetic acid	79-11-8	1.0	10.2			8/7/97		
Bromoacetic acid	79-08-3	0.5	6.4			8/7/97		
Dichlomacetic acid	79-43-6	0.5	0.4 39.1			8/7/97		
Trichloroacetic acid	75-03-9	0.5	34.1			8/7/97		
Bromochloroacetic acid	5589-96-3	0.5	26.0			8/7/97		
Dibromoacetic acid	63164-I	0.5	12.5			8/7/97		
2,3-Dibromopropanoic acid	600-05-5		119%	\$S				
Trihalomethanes • EPA 502.1	2							
Chioroform	67-66-3	0.5	131	E	1	8/11/97		
Bromodichloromethane	75-27-4	05	965			8/11/97		
Dibromochloromethane	124-49-l	0.5	72.3			8/11/97		
Bromoform	75-25-z	0.5	105			8/11/97		
1,2-Dichloroethane-d4	17068-07-0		96%	SS				
	;	· <b>_</b>						
E=Exceeded instrument cali SS=Surrogate standard	bration range							

 Applied Sciences Laboratory
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#### CH2IVIHILL Ansiyilesi Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LMG 2567 Fairlane Drive
 Monigomery, AL 36118-1622
 (334) 271-3428

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ULAQ 5090 Caterpillar Road Redding, CA 98003-1412 8 (916) 244-8227 FAX (916) 244-4109

LLKW Canviro Analytical Laboratoriles, Inc. 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5 (519) 747-2575 FAX (519) 747-3808

[.] CV0 2300 NW Walnut Boulevard Corvallis, OR 87330-3638 (541) 752 4271 FAX (541) 752-0278

COC #

Project #	Purchase Order #		·	Requested Analytic	al Method #	THIS AREA FOR LAB, USE ONLY
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Project Name	, <u>, , , , , , , , , , , , , , , , , , </u>	- 1				5872-1-13 1
McAllen Pilot	Studu					Lab PM Custody Review
Company Name						
McAtlen Publ	ic Utilities					Log in LIMS VerHication
Project Manager or Contact & Phone # Rosic Villarieal	Report Copy to:	Ĭ	5			
Rosic Vinacheat	Jim Geisbush	ā	<b></b> 8.			
Requested Campletion Date: Site ID	Sample Dispos					pH Custody Seals Y N
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		8				DC Level 1 2 3 Other
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	CLIENT SAMPLE ID LA (9 CHARACTERS) Q		10% 5 1740 10%			
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CH2IviHiLL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES UMC 2567 Fektene Drive Montgomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Calexpiler Road Redding, CA 96003-1412 (916) 244-5227 FAX (916) 244-4109

UKW Carwiro Analytical Laboratories, inc. 50 Bathurst, Unit 12, Waterloo, Ontario, Canada N2V 2C5 (519) 747-2576 FAX (519) 747-3805

El CVO 2300 NW Walnut Boulevard * ' Corvalis, OR 97330-3636 (541) 752-4271 FAX (541) 752-0278 COC #

Project # Purchase Orde	- 41													
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McAllen Pilot Study			Î			135	9					5787-12	19 (	. (
Company Name			1î		1	NH1-N						Lab PM	Custody	Review
McAllen Public Utilities						₿ Z	141							
Project Manager or Contect & Phone # Report Copy to	:		9	-	え	4 1		$ \left[ \right] $				Log In	LIMS Veri	ification
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# MONTHLY BILLING SUMMARY

Applied Sciences Laboratory

CH2MHILL Corvallis, Oregon 2300 NW Walnut Blvd, Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0275

City of McAllen Pilot study Project Manager: Jim Lozier/PHX

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Invoice Date 07/22/97 Invoice No. A97-1364

Page 1 of 1

-	ustomer Number 1 <b>38067.A8.22</b>	CH2M Hill Rep. Ginger Collins	Billing Per 8/27/9		erence No. 5787
Qty	Description		Trans. Date	Unit Cost	Subtotal
<b>2</b> 2 2 3	Color(ALPHA) Apparent Ammonia Nitrate/Nitrite Total Phosphorus Trihalomethane & Haloacetic Acids For (THM/HAAFP)	rmation Potential	7/22/97 7/22/97 7/22/97 7/22/97 7/22/97 7/22/97	\$20.00 <b>\$20.00</b> \$35.00 <b>\$25.00</b> 8135.00	\$40.00 \$40.00 \$70.00 \$50.00 \$405.00
2 2	Total <b>Kjeldahi</b> Niiogen Total Organic <b>Carbon</b>		7/22/97 7/22/97	<b>\$35.00</b> \$40.00	\$70.00 <b>\$80.00</b>

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Total Amount Billed: \$755.00

Our records indicate that me **above tests** were **requested during** me current billing period. Please notify the laboratory **listed above** ii there are any discrepancies.

- PROJECT COPY -

projinv.rdf nev 7-10-97

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# MONTHLY BILLING SUMMARY



**Applied Sciences Laboratory** 

CH2MHILL. Corvallis, Oregon 2300 NW Walnut Blvd, Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

Cii of McAllen Pilot Study Pmject Manager: Jim Lozier/PHX

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Invoice Date 08/04/97 Invoice No. A97-1446

Page 1 Of 1

r' -	-	ustomer Number 1 <b>38067.A8.ZZ</b>		CH2M Hill Rep. Ginger Collins	Billing <b>Per</b> <b>8/27/9</b>		erence No. 5872
	Oty		Description		Trans. Date	Unit Cost	Subtotal
	3 3	Haloacetic Acids Trihalomethanes by	y Purge & Trap		8/4/97 8/4/97	\$225.00 \$75.00	

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Total Amount Billed: \$900.00

Our **records** indicate **that** the **above** tests were requested during me current billing **period**. Please notify me **laboratory listed above** if mere **are** any **discrepancies**.

- PROJECT COPY -

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projinv.rdl rev 7-10-97



CH2M HILL 2300 NW Walmut Blvd. Corvallis, OR 97330-3538 Mailing address: PO. 80x 428 Corvallis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

August 18.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Dam for City of McAllen CVO Laboramry Reference No. 5846

### Jim Geisbush/PHX

On July 30, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control dam are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under **CH2M** HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M** HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

WellerFrance

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvatiis Office

Applied Sciences Laboratory 2300 NW Wainut Blvd., Corvatilis, OR 97330-3538 P. O. Box 428, Corvattis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5846

cvo Sample ID	Client Sample ID	Date Collected	Time Collected
584601	Zeeweed Feedwater	07/29/1997	
584602	Zeeweed Permeate	0 <b>7/29/</b> 1997	
584603	Memcor Filtrate	07/29/1997	

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### CASE NARRATIVE GENERALCHEMISTRY

### Client/Project: City of McAllen

- I. <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: Digested standard for TKN bad 66% recovery. Subsequent analysis produced 88% recovery. Acceptance criteria for other analyses were met.

### III. <u>Analysis</u>

- A. <u>Calibration</u>: All accaptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. Lab Control Sample(s):
   Lab Control recovery for TKN was 72%. Subsequent analysis recovery was 100%. Criteria for all other analyses were met.
- F. <u>Other</u>. Nor applicable.
- Iv. Documentation Exceptions: None.

e

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Lelen Van Nice</u> Reviewed by: <u>Lingu Collins</u>

Project Mana sampled Client Sample Sampling D Sampling T Ty Ma	ime: Cii of McAll ger: Rosie Villarreal By: R. Villarreal ID: Zeeweed Fea ate: 07/29/97 ime: Not indicated /pe: Grab trix: waler usis: As received	edwater	Report	Date Rec'o	y: HVN	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry N-NO3/NO2 TKN P-Total Phosphorus TOC	0.1 1.0 25 10.0	0.1 109 29.1 45.4	U	mg/L mg/L mg/L	EPA 353.2 EPA 351.4 EPA 365.1 EPA 415.1/2	7/31/97 8/12/97
U=Not detected at sp	ecified reporting I	imits		and the second second second second second second second second second second second second second second secon		<u></u> is:

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 2300 NW Walnut Blvd., Corvallis, OR 97330-3538

 Corvallis Office
 P.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276 ...

Sampled By: R. Villarreal       Report Revision No.: 0         Client Sampling Date: 07/29/97       Reviewed By: HVN         Sampling Date: 07/29/97       Reviewed By: Grack         Sampling Time: Not indicated       Type: Grab         Matrix: water       Basis: As received         Analyte       Limit         Reporting       Sample         Optimizer       Date         Analyte       Limit         Result       Qualifier         Units       Method         Analyte       1.0         P-Total Phosphorus       0.05         1.0       9.3         mg/L       EPA 35.1         8/12/97       Too         1.0       9.3         mg/L       EPA 110.2         Color (ALPHA)       Apparent         5       2.5	Client Information Project Name: Project Manager:	City of McAlle Rosie Villarre		ty	Lab II	1: 07/ <b>30/97</b> D: <b>584602</b>	
Matrix: water Basis: As received         Date           Reporting         Sample Result         Date           Analyte         Limit         Result         Qualifier         Units         Method         Analyzed           Chemistry         N-NO3/NO2         0.1         6.4         mg/L         E P A 3 5 3 2         8/15/97           TKN         1.0         29         mg/L         EPA 351.4         7/31/97           P-Total Phosphorus         0.05         1.3         mg/L         EPA 365.1         8/12/97           Too         1.0         9.3         mg/L         EPA 415.1/2         8/7/97	Client Sample ID Sampling Dale: Sampling Time:	: Zeeweed Pe 07/29/97 Not indicated		•	Reported By	/: HVN	
Analyte         Limit         Result         Qualifier         Units         Method         Analyzed           Chemistry         N-NO3/NO2         0.1         6.4         mg/L         E P A 3 5 3 2         8/15/97           TKN         1.0         2.9         mg/L         EPA 351.4         7/31/97           P-Total Phosphorus         0.05         1.3         mg/L         EPA 365.1         8/12/97           Too         1.0         9.3         mg/L         EPA 415.1/2         8/7/97	Matrix:	water					
N-NO3/NO2         0.1         6.4         mg/L         E P A 3 5 3 2         8/15/97           TKN         1.0         29         mg/L         EPA 351.4         7/31/97           P-Total Phosphorus         0.05         1.3         mg/L         EPA 365.1         8/12/97           Too         1.0         9.3         mg/L         EPA 415.1/2         8/7/97	Analyte			Qualifier	Units	Method	Date <b>Analyzed</b>
P-Total         Phosphorus         0.05         1.3         mg/L         EPA 365.1         8/12/97           Too         1.0         9.3         mg/L         EPA 415.1/2         8/7/97	N-NO3/NÖ2	0.1	6.4		mg/L	E P A 3 5 3 2	8/15/97
	P-Total Phosphorus	0.05	1.3		mg/L	EPA 365.1	8/12/97
		-			-		

U=Not detected at specified reporting limits

Applied Sciences Laboratory Corvalis Office

**—**.

2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Bax 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276 • 2

Corvallis Applied Project Name: Project Manager: Sampled By: Client Sample ID: Sampling Date: Sampling Time: Type: Matrix: Basis:	Cii of McAller Rosie Villarrea R. Villarreat Memcor Filtra 07/29/97 Not indicated Grab	n Pilot Stud al	Lat ly Report		1: 07/30/97 D: 584603 .: 0 v: HVN	
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyz <u>ed</u>
<b>Chemistry</b> N-NO3/NO2 TKN P-Total phosphorus TOC Color (ALPHA) Apparent	0.1 1.0 0.05 1.0 5	0.7 1.1 0.6 7.6 1 5		mg/L mg/L mg/L mg/L	EPA 361.4 EPA 366.1 E P A 415.	7/31/97 8/12/97 1/2 8/7/97

U=Not detected at specified reporting limits

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Applied Sciences Laboratory2300 NW Walnut Bivd., Corvaliis, OR 97330-3538Corvatilis OfficeP.O. Box 428, Corvatilis, OR 97339-0428 Corvatiis Office

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(541) 752-4271 Fax No.(541) 752-0276

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### CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CI LMR 2667 Feidene Dobe Monigomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

 Chill Stopp Caterphiler Road
 Chill WC Canviro Analytical Laboratories, Inc.

 Redding, CA 96003-1412
 S0 Balhurst, Unit 12, Waterico, Onlario, Canada N2V 2C5

 (#18) 244-5227
 FAX (918) 244-4109

 (5) 197 747-2575
 FAX (519) 747-3808

Covalis, OR 97330-3638 (541) 752-4271 FAX (541) 752 0276

COC #

Purchase Order # Project # THIS AREA FOR LAB LISE ONLY Requested Analytical Method # 38067. A.Ø. 7.7. Lab # Page of 7 17 5846173 т Project Name . `` Ó Ť MALLEN l eh PL **Custody Review** オマ・コイロマ 6 hay ï Company Name . Mullen Public 11+1 lities LIMS Verification ٥ 1 Loa in Project Manager or Contact & Phone # Color Report Copy to: Ē ROSSEVIIIAdas C C ( Phoenix) Jim Geisbush 956-431-8340 ŌĦŦ ł 5 2 рĦ Requested Completion Date: Site ID Custody Seals Y N Samola Disposal: Slepcer Asturn lca. YN WWTP#2 Preservative ASAP Ň . . QC Level 1 2 3 Other ____ Matela Тура #25 Ou W S A O COMP G Ś Sempling **Cooler Temperature** LAB CLIENT SAMPLE ID 6 £ (9 CHARACTERS) 0C Ŧ 2 Time Dale Alternate Description Lab ID 6 2 1/27/97 d 2 юe mee 2 w ked md Ċ. ..... Чſ Ma. 484 20 a fart fill i 2 Ei mien <u>c 12</u> IIŁ. COLLE FiltHcalte M clar i t m Im LM 11-Ira 0£ . **Emply Bottles** Empty Bottles Date/Time Date/Time A n Received By Relinguished By . Thalas 1:41 X chain Phase up and provingmest 7/24/97 10010 villand 9 a . . ^ 46 11 Date/Time g .m Date/Time Relinguished By Sampjed By and Title (Please sign and print name) 7-19.97 Y Lallan 10:10 749/07 9:55 acique. Porez AM main Date/Time (Please sign and wint name) Relinguisted By-Date/Time (Please sign and print name) **Received By** 7/29/97 ຝ ROSIEVillAREAL Roen vullaner ioop.m. 7/24/47 10:10. train VI Manuel ROSIE VILLARES Shipping # Date/Time Shipped Vig (Please sign and print name) **Received By** 730 1030 UPS (FOJER) Precisi Instruction Other

# MONTHLY BILLING SUMMARY



Applied Sciences Laboratory Corvallis, Oregon 2300 NW Walmut Elva. Corvattis. OR 97330-3538 P.O. Box 428, Corvattis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Pilot Study Project Manager: Jim Lozier/PHX

Invoice Date 07/30/97 Invoice No. A97-1422

Page 1 Of 1

-	Customer Number		CH2M Hill Rep. Ginger Collins	Billing Pe <b>8/27/9</b>		erence No. 5846
Qty		Description		Trans. Date	Unit Cast	Subtotal
<b>2 3</b> 3 3 3 3 3 3	Color (ALPHA) Ap Ammonia Nitrate/Nitrite Total Phosphorus Total Kjeldani Ni Total Organic Carl	lien		7/30/97 7/30/97 7/30/97 7/30/97 7/30/97 7/30/97 7/30/97	\$20.00 \$20.00 \$35.00 \$25.00 \$35.00 \$40.00	\$60.00 \$105.00 \$75.00 \$10S.00
	(THIS IS N	NOTA BILL-DO NOTS	UBMIT PAYMENT)	Tota	I Amount Bill	ed: <b>\$505.00</b>

Our **records** indicate that the above tests **were** requested during the current billing **period**. **Please notify** the laboratory **listed** above if there are any **discrepancies**.

### - PROJECT COPY -

property rat ray 7-10-97

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CH2M HILL 2300 NW Watnut Blvd Corvallis. OR 97330;3538 Mailing address: P.O. Box 428 Corvallis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0275

August 21, 1997

City of McAllen pilot Study

138067.A8.ZZ

RE: Analytical Data for City of McAllen pilot Study CVO Laboratory Reference No. 5875

Jim Lozier/PHX

On August 5, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we win contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have ally questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Willignace

Kelly Ensor Senior Administrative Assistant

. .

Enclosures

Applied Sciences Laboratory 2300 NW Watnut Blvd., Corvatlis, OR 97330-3538 Corvatis Office P. O. Box 428, Corvatlis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276 1.

APP-128

## CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5875

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
587501	Zeeweed Feedwater	08/04/1997	
587502	Zeeweed Permeate	08/04/1997	
587503	Memcor Filtrate	08/04/1997	

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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5875

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### Client/Project: City of McAllen Pilot Study

- I. <u>Holding lime:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. <u>Analysis</u>
  - A. <u>libration</u>: All acceptance criteria were met.
  - B. <u>Blanks</u>: All acceptance criteria were met.
  - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions:</u> None.

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

-

Prepared by: <u>Anger Collins for Helen Van Nics</u> Reviewed by: <u>Aura Hone Terson</u>

Project Manager Sampled By Client Sample ID sampling Date	n : City of McAlle : Rosie Villarrea : R. Villarreal : Zeeweed Fee	en Pilot Stud al edwater	Lab I ly Report R R	Date Rec'd Lab ID evision No. eported By	: 587501 : 0	
Туре	: Grab					
	c: water s: As received					
Analyte	Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
N-NO3/NO2	0.1	0.1	- U	mg/L	EPA 353.2	8/15/97
N-Ammonia	120.0	22.9		mg/L mg/L	EPA 351.4 SM4500-NH3-D	8/7/97 8/7/97
P-Total Phosphorus	025	4.8		mg/L	EPA 355.1	8/12/97
TOG	10.0	55.4		mg/L	EPA 415.1/2	8/8/97
U=Not detected at spec	ified reporting li	imits				

 Applied Sciences Laboratory
 2300 NW Walnut Blvd., Corvallis, OR 97330-3538

 Corvatils Office
 P.O. Box 428, Corvalis, OR 97339-0428

(\$41) 752-4271 Fax No.(541) 752-0276

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Project Manager: Sampled By: Client Sample ID: Sampling Date: Sampling Time: Type: Matrix:	City of McAlle Rosie Villarrea R. Villarreal Zeeweed Pen 08/04/97	en Pilot Stud al	<u>Lab Inf</u> y Da Report Rev Rep	Lab ID: vision No. ported By:	08/05/97 587502 : 0	
Analyte	Reporting <b>Limit</b>	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry TKN N-Ammonia P-Total Phosphorus TOC Color (ALPHA) Apparent N-Nitrate N-Nitrite U=Not detected at specifi	0.1 0.1	<b>1.3</b> <b>0.67</b> 3.4 7.6 <b>20</b> 17.4 1.7		mg/L mg/L mg/L mg/L mg/L		8/7/97 8/12/97 8/8/97 8/5/97 8/6/97 8/6/97

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 Corvalis Office P.O. Box 428, Corvalis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

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ationProject Name: City ofProject Manager: Rosie VSampled By: R. VillarClient Sample ID: M-rsampling Date: 08/04/9Sampling Time: Not indType: GrabMatrix: waterBasis: As recerReportAnalyteChemistryN-NO3/NO20.1TU N1.0N-Ammonia0.10TO CColor (ALPHA)Apparent5	/illarreal rreal Filtrate 77 dicated eived eived <b>ting Sample</b>	udy Di Report Rev Rep Rev	ate Rec'd: 08 Lab ID: 58 vision No.: 0 ported By: HV riewed By: 2	7 <b>50</b> 3 /N	
Analyte         Lim           Chemistry         0.1           N-NO3/NO2         0.1           TU N         1.0           N-Ammonia         0.10           P-Total Phosphorus         0.0           TD C         1.0					
N-NO3/NÓ2         0.1           TU N         1.0           N-Ammonia         0.10           P-Total Phosphorus         0.0           TD C         1.0			Units	Method	Date Analyzed
U=Not detected at specified repo	1.0         0       0.10         05       0.80         0       6.4	U U	mg/L I mg/L SM mg/L mg/L E	EPA 353.2 EPA 351.4 M4500-NH3-D EPA 365.1 EPA 415.1/2 EPA 1102	8/15/97 8/7/97 8/12/97 8/8/97 8/5/97

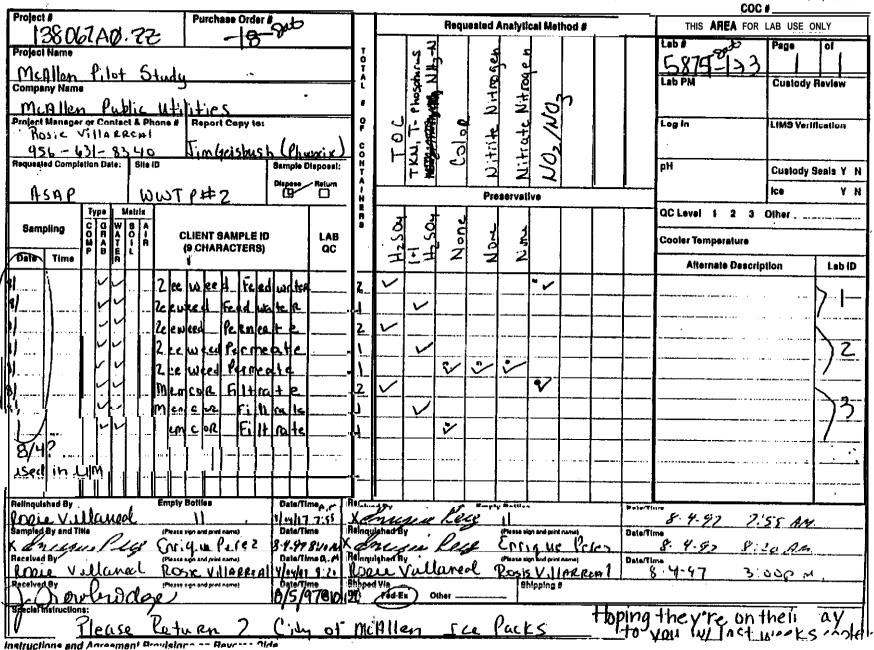
Applied Sciences Laboratory2300 NW Walnut Blvd., Corvallis, OR 97330-3538Corvallis OfficeP.O. Bax 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES EMQ 2567 Faktane Drive Monigomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Caterpillar Road Redding, CA 96003-1412 (916) 244-5227 FAX (916) 244-4109

 Still Canvico Analytical Laboratories, Inc. So Bathurai, Unit 12, Walerloo, Ontario, Canada N2V 2C5 (619) 747-2575 FAX (519) 747-3806



# MONTHLY BILLING SUMMARY



CH2MHILL Corvaliis, Oregon 2300 NW Watnut Bive, Corvaliis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Pilot Study Project Manager Jim Lozier/PHX

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Invoice Date 08/05/97 Invoice No. A97-1451

Page 1 of 1

•	ustomer Number 138067.A8.ZZ	CH2M Hill Rep. Ginger Collins	Billing Per 8/27/9		Referenc <b>ce No.</b> 5875	
Qty	Descriptio	n	Trans. Date	Unit Cost	Subtotal	
2	Color (ALPHA) Apparent		8/5/97	\$20.00	\$40.00	
3	Ammonia		8/5/97	\$20.00	\$60.00	
2	Nitrate/Nitrite		8/5/97	\$35.00	\$70.0	
1	Nitrate		8/5/97	\$30.00	\$30.0	
1	Nitrite		8/5/97	\$20.00	\$20.0	
3	Total Phosphorus		8/5/97	\$25.00	\$75.0	
3	Total Kjeldani Nitrogen		8/5/97	\$35.00	\$105.0	
3	Total Organic Carbon		8/5/97	\$40.00	\$120.0	

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)

Totai Amount Billed: \$520.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above ii there are any discrepancies.

- PROJECT COPY -

projinv.rdl rev 7-10-97

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# MONTHLY BILLING SUMN

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## Applied Sciences Labora



CH2MHILL Corvallis, Oregon 2300 NW Wainut Blvd, Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Project Manager: Jim Lozier/PHX

!

Invoice Date08/12/97 Invoice No.A97-1492

Page 1 Of 1

-	ustomer Number 38067.A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Pe <b>9/10/9</b>		Reference No. 5916	
Qty	Description		Trans. Date	Unit Cost	Subtotal	
2	Color (ALPHA) Apparent		8/12/97	\$20.00	\$40.00	
3	Ammonia		8/12/97	\$20.00	\$60.00	
2	Nitrate/Nitrite		8/12/97	\$35.00	\$70.00	
1	Nitrate		8/12/97	\$30.00	\$30.00	
1	Nitrite		8/12/97	\$20.00	\$20.00	
3	Total Phosphorus		8/12/97	\$25.00	\$75.00	
3	Total Kieldahi Nitrogen	1	8/12/97	\$35.00	\$105.0	
3	Total Organic Carbon	)	8/12/97	\$40.00		

(THIS IS NOT A BILL -DO NOT SUBMIT PAYMENT)

Total Amount Billed: \$520.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

projime.rdt new 7-10-97



CH2M HULL 2300 NW Walnut Blind. Corvallis, OR 97330-3538 Mailing address: P.O. Box 428 Corvellis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

August 29.1991

City of McAllen

138067.A0.ZZ

Analytical Data for City of McAllen RE: CVO Laboratory Reference No. 5916

Jim Lozier/PHX

On August 12, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235. extension 3120.

Sincerely,

Weller France

Kelly **Ensor** Senior Administrative Assistant

Enclosures

Corvatis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvatis, OR 97330-3538 Corvatis Office P O Bas 428 Conveilis, OD 97330-0498 P. O. Bax 428, Corvalis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5916

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CVO Sample ID	Client Sample ID	Date Collected	Time Collected
591601	Zeeweed Feedwater	08/11/1997	11:08
591602	Zeeweed Permeate	08/11/1997	11:08
591603	Memcor Filtrate	08/11/1997	11:08

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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5916

#### Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None

### III. <u>Analysis</u>:

- A. <u>Calibration</u>: All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- c. <u>Matrix Spike Sample(s)</u>: Matrix spike not available for TOC and NO3/NO2. All other acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
- F. <u>Other</u>: Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Helen Van Nice</u> Reviewed by: <u>Singer Collins</u>

Corvallis Applied Sciences Laboratory												
Clinitation Cii of McAllen Pilot Study Date Rec'd: 08/12/97 Project Nanager Rosie Villarreal Lab ID: 591601 sampled By: R. Villarreal Report Revision No.: 0 Client Sample ID: Zeeweed Feedwater Reported By: HVN Sampling Date: 08/11/97 Reviewed By: grac. Sampling Time: 11:08 Type: Grab Matrix: Water Basis: As received												
Analyte	Reporting Sample Date											
Chemis N-NO3/ N-Amma TKN P-Total TOC	ntry NO2 onia Phosporus	0.1 0.4 5 5.0 10.0	0.1 14.6 46.1 41 .0 43.4	U	mg/L mg/L mg/L mg/L	EPA 353.2 SM4500-NH3-D EPA 351.4 EPA 365.1 EPA 415.1/2	8/15/97 8/19/97 8/19/97 8/27/97 8/22/97					
			nins			· · · · · · · · · · · · · · · · · · ·						

 Applied Sciences Laboratory
 2300 NW Walnut Bivd., Corvalis, OR 97330-3538
 (541) 752-4271

 Corvalis Office
 P.O. Box 428, Corvalis, OR 97339-0428
 Fax No.(541) 752-0276

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Corvallis Applied Sciences Laboratory	Convallie Applied	Sciences	Labora	tory									
Projev Name: Citv, of McAllen Pilot Study       Date Rect: 08/12/97         Project Manager: Rosie Villarreal       Report Revision No: 0         Sampled Dy: R. Villarreal       Report Revision No: 0         Client Sample IO: Zeeweed Permeate       Report Revision No: 0         Sampling June: 11:08       Revision No: 0         Type: Grab       Revision No: 0         Matrix: water       Basis: As received         Anafyte       Reporting Sample       Date         Chemistry       mg/L         N-Nitrate       0.1       15.8       mg/L         EVALUATION       1       1       U       EPA 300       8/12/97         N-Nitrate       0.1       0.6       mg/L       EPA 335.1       8/27/97         Tock       1       1       U       mg/L       EPA 335.1       8/27/97         Tock       1.0       7.5	Curvains Applied	Sciences	Labora	tory									
Project Manager: Rosie Villarreal Sampled By: R. Villarreal Client Sample IO: Zeeweed Permeate Sampling Date: 08/1 1/97 Sampling Date: 08/1 1/97 Sampling Ime: 11:08 Type: Grab Matrix: water Basis: As received       Report Revision No:: 0 Report By: HVN Reviewed By: gymc_ Sampling Ime: 11:08 Type: Grab Matrix: water Basis: As received         Anafyte       Reporting Limit       Sample Result       Date Qualifier       Date Matrix: Water Basis: As received         Chemistry       mg/L       EPA 300 EPA 300 B'12/97       B'12/97 N-Nitrate         N-Nitrate       0.1       0.1       U         EPA 300 N-Ammonia       0.1       0.6 Matrix: Result       B'12/97 S'12/97         N-Nitrate       0.1       0.1 0.5       mg/L TKN       EPA 300 B'12/97         N-Ammonia       0.1 0.5       7.0 0.5       mg/L TC       EPA 351.4 B'12/97         P-Total Phosporus       0.5 0.5       7.0 0.5       mg/L TC       EPA 310.2 B'13/97         Color (ALPHA) Apparent       5       20       mg/L TC       EPA 110.2 B'13/97	Cile			Lab L			1						
Sampled By: R. Villarreal       Report Revision No.: 0         Client Sampling Date: 08/11/97       Reviewed By: GVC_         Sampling line: 11:08       Type: Grab         Matrix: water       Basis: As received         Basis: As received       Cualifier         Units       Method         Anafyte       Limit         Result       Qualifier         Units       Method         Anafyte       15.8         Monitation       Mg/L         N-Nitrate       0.1         0.1       0.6         Matrix:       8/12/97         N-Nitrate       0.1         0.1       0.6         Mg/L       EPA 300         By 12/97         N-Nitrate       0.1         0.1       0.6         Mg/L       EPA 300         By 22/97         N-Ammonia       0.1         1       1         Value       Mg/L         EPA 385.1       8/12/97         TKN       1       1         P-Total Phosporus       0.5       7.0         Mg/L       EPA 351.4       8/12/97         Color (ALPHA) Apparent       5       20 <th></th> <th></th> <th></th> <th>ty E</th> <th></th> <th></th> <th>⊥,</th>				ty E			⊥,						
Client Sample 10: Zeeweed Permeate Reported By: HVN Sampling Line: 08/1 1/97 Sampling Line: 11:08 Type: Grab Matrix: water Basis: As received Chemistry mg/L N-Nitrate 0.1 15.8 mg/L N-Nitrate 0.1 0.1 U EPA 300 8/12/97 N-Nitrate 0.1 0.6 mg/L SM4500-NH3-D 8/12/97 TKN 1 1 U mg/L EPA 300 8/12/97 TKN 1 1 U mg/L EPA 300 8/12/97 TKN 1 1 2 PA 300 8/12/97 TKN 1 1 2 PA 308 2/12/97 Color (ALPHA) Apparent 5 20 mg/L EPA 110.2 8/13/97			al										
Sampling Date: 08/1 1/97       Reviewed By: gmc.         Sampling lime: 11:08       Type: Grab         Matrix: water       Basis: As received         Anafyte       Result       Qualifier       Units       Method       Anatyzed         Chemistry       mg/L       Hethod       Anatyzed       Method       Anatyzed         N-Nitrate       0.1       15.8       mg/L       EPA 300       8/12/97         N-Nitrate       0.1       0.6       mg/L       SM4500-NH3-D       8/19/97         N-Nitrate       0.1       0.6       mg/L       EPA 300       8/12/97         N-Nitrate       0.1       0.6       mg/L       EPA 300       8/12/97         N-Nitrate       0.1       0.6       mg/L       EPA 300       8/12/97         TKN       1       t       U       mg/L       EPA 385.1       8/27/97         TOC       1.0       7.5       mg/L       EPA 415.1/2       8/22/97         Color (ALPHA) Apparent       5       20       mg/L       EPA 110.2       8/13/97							1						
Sampling lime: 11:08 Type: Grab Matrix: water Basis: As received Thereistry received Chemistry receiv			meate										
Type:       Grab Matrix:       water Basis:       Sample Result       Date         Anafyte       Limit       Result       Qualifier       Units       Method       Anafyzed         Chemistry       mg/L       Method       Anafyzed       Method       Anafyzed         N-Nitrate       0.1       15.8       mg/L       EPA 300       8/12/97         N-Nitrate       0.1       0.6       mg/L       EPA 300       8/12/97         N-Ammonia       0.1       0.6       mg/L       SM4500-NH3-D       8/19/97         TKN       1       1       U       mg/L       EPA 351.4       8/19/97         P-Total Phosporus       0.5       7.0       mg/L       EPA 385.1       8/27/97         TOC       1.0       7.5       mg/L       EPA 415.1/2       8/22/97         Color (ALPHA) Apparent       5       20       mg/L       EPA 110.2       8/13/97			vieweu by	gne									
Matrix: water Basis: As received         Sample Result         Date           Anafyte         Limit         Result         Qualifier         Units         Method         Anatyzed           Chemistry         mg/L         Model         Method         Anatyzed         Method         Anatyzed           N-Nitrate         0.1         15.8         mg/L         EPA 300         8/12/97           N-Nitrate         0.1         0.6         mg/L         SM4500-NH3-D         8/19/97           N-Ammonia         0.1         0.6         mg/L         SM4500-NH3-D         8/19/97           TKN         1         t         U         mg/L         EPA 385.1         8/27/97           P-Total Phosporus         0.5         7.0         mg/L         EPA 415.1/2         8/13/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97		•											
Basis: As received         Reporting         Sample Result         Qualifier         Units         Method         Anatyzed           Chemistry         mg/L         Method         Anatyzed         Method         Anatyzed           N-Nitrate         0.1         15.8         mg/L         EPA 300         8/12/97           N-Nitrate         0.1         0.1         U         EPA 300         8/12/97           N-Ammonia         0.1         0.6         mg/L         SM4500-NH3-D         8/12/97           P-Total Phosporus         0.5         7.0         mg/L         EPA 385.1         8/27/97           TOC         1.0         7.5         mg/L         EPA 415.1/2         8/22/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97													
Reporting Anafyte         Sample Result         Oualifier         Units         Method         Anatyzed           Chemistry         mg/L         Method         Method         Anatyzed           N-Nitrate         0.1         15.8         mg/L         EPA 300         8/12/97           N-Nitrate         0.1         0.1         U         EPA 300         8/12/97           N-Nitrate         0.1         0.1         U         EPA 300         8/12/97           N-Ammonia         0.1         0.6         mg/L         SM4500-NH3-D         8/19/97           TKN         1         t         U         mg/L         EPA 331.4         8/19/97           TKN         1         t         U         mg/L         EPA 335.1         8/27/97           TOC         1.0         7.5         mg/L         EPA 415.1/2         8/22/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97													
Anafyte         Limit         Result         Qualifier         Units         Method         Anafyzed           Chemistry         mg/L         mg/L         EPA 300         8/12/97           N-Nitrate         0.1         15.8         mg/L         EPA 300         8/12/97           N-Nitrate         0.1         0.6         mg/L         EPA 300         8/12/97           N-Ammonia         0.1         0.6         mg/L         EPA 351.4         8/19/97           TKN         1         1         U         mg/L         EPA 351.4         8/12/97           P-Total Phosporus         0.5         7.0         mg/L         EPA 385.1         8/27/97           TOC         1.0         7.5         mg/L         EPA 415.1/2         8/22/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97	↓ <del>↓</del>												
Chemistry         mg/L           N-Nitrate         0.1         15.8         mg/L         EPA 300         8/12/97           N-Nitrite         0.1         0.1         U         EPA 300         8/12/97           N-Ammonia         0.1         0.6         mg/L         EPA 300         8/12/97           N-Ammonia         0.1         0.6         mg/L         EPA 301         8/19/97           TKN         1         t         U         mg/L         EPA 351.4         8/19/97           P-Total Phosporus         0.5         7.0         mg/L         EPA 385.1         8/27/97           TOC         1.0         7.5         mg/L         EPA 415.1/2         8/22/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97			-										
N-Nitrate       0.1       15.8       mg/L       EPA 300       8/12/97         N-Nitrite       0.1       0.1       0       EPA 300       8/12/97         N-Ammonia       0.1       0.6       mg/L       SM4500-NH3-D       8/19/97         TKN       1       t       U       mg/L       EPA 351.4       8/19/97         TKN       1       t       U       mg/L       EPA 351.4       8/19/97         P-Total Phosporus       0.5       7.0       mg/L       EPA 385.1       8/27/97         TOC       1.0       7.5       mg/L       EPA 415.1/2       8/22/97         Color (ALPHA) Apparent       5       20       mg/L       EPA 110.2       8/13/97	Anafyte	Limit	Result	Qualifier	Units	Method	Analyzed						
N-Nitrate       0.1       15.8       mg/L       EPA 300       8/12/97         N-Nitrite       0.1       0.1       0       EPA 300       8/12/97         N-Ammonia       0.1       0.6       mg/L       SM4500-NH3-D       8/19/97         TKN       1       t       U       mg/L       EPA 351.4       8/19/97         TKN       1       t       U       mg/L       EPA 351.4       8/19/97         P-Total Phosporus       0.5       7.0       mg/L       EPA 385.1       8/27/97         TOC       1.0       7.5       mg/L       EPA 415.1/2       8/22/97         Color (ALPHA) Apparent       5       20       mg/L       EPA 110.2       8/13/97	Chemistry				ma/L								
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N-Ammonia         0.1         0.6         mg/L         SM4500-NH3-D         8/19/97           TKN         1         t         U         mg/L         EPA 351.4         8/19/97           P-Total Phosporus         0.5         7.0         mg/L         EPA 385.1         8/27/97           TOC         1.0         7.5         mg/L         EPA 415.1/2         8/22/97           Color (ALPHA) Apparent         5         20         mg/L         EPA 110.2         8/13/97		-		U									
P-Total Phosporus 0.5 7.0 mg/L EPA 385.1 8/27/97 TOC 1.0 7.5 mg/L EPA 415.1/2 8/22/97 Color (ALPHA) Apparent 5 20 mg/L EPA 110.2 8/13/97	-		-	·	mg/L		+·· · = - ·						
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 Applied Sciences Laboratory
 2300 NW Walnut Blvd., Corvalis, OR 97330-3538

 Corvalis Office
 P.O. Bax 428, Corvalis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

Lab Information         Project Name: City of McAllen Pilot Study       Date Rec'd: 08/1 2/97         Project Manager: Rosie Villarreal       Lab ID: 941603         Sampled By: R. Villarreal       Report Revision No.: 0         Client Sample ID: Memcor Filtrate       Reported By: HVN         Sampling Date: owl 1/97       ReviewedBy: model         Sampling Time: 11:08       Type: Grab         Matrix: Water       Basis: As received									
Analyte	Reporting Limit	Sample <b>Result</b>	Qualifier	Units	Method	Date Analyzed			
Chemistry N-NO3/NO2 N-Ammonia TKN P'-Total Phosporus TOC Color (ALPHA) Apparent	0.1 0.1 <b>1</b> 0.05 1.0 5	2.8 0.1 2 3 1.77 7.6 5		mg/L mg/L mg/L mg/L	EPA 353.2 SM4500-NH3-D EPA 351.4 EPA 365.1 EPA 415.1/2 EPA 110.2	8/15/97 8/19/97 8/27/97 8/22/97 8/13/97			

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 Applied Sciences Laboratory
 2300 NW Walnut Blvd., Corvallis, OR 97330-3538

 Corvallis Office
 P.O. Bax 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No. (541) 752-0276 CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

[] LMG 2587 Feidene Drive Monigomery, AL 38116-1622 (334) 271-1444 FAX (334) 271-3428

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EUKW Cenviro Analytical Laboratories, Inc. 50 Balhuest, Unit 12, Waterkoo, Ontario, Canada N2V 2C5 (519) 747-2575 FAX (519) 747-3806

LICVO 2300 NW Wahut Bouleverd Corvellis, OR 97330-3636 (541) 752-4271 FAX (541) 752-0276

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Phase II Data

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CH2M HILL 2300 NW Walnut Blvg. Corvalis, OR 97330-3538 Mailing address: P.O. Box 428 Convertise OB 97339-0428 Tel 541.752.4271 Fex 541,752,0275

June 25, 1997

Cii of McAllen

138067.A0.ZZ

Analytical Data for City of McAllen RE: CVO Laboratory Reference No. 5357 and 5467

### Jim Geisbush/PHX

On May 20. 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters. From these samples 3 more were created for THM's and HAA's.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under **CH2M** HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as **hazardous** waste.

The CH2M HILL Applied Sciences laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if yoo need additional information, please call Ms. Kathy McKinley at (541) 758-0235. extension 3120.

Sincerely,

Wellerforcer

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvallis Office . .

Applied Sciences Laboratory 2300 NW Walnut Bivd., Corvalis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276 Z,

### CLIENT SAMPLE CROSS-REFERENCE

CH2M	HILL	Applied	Science	Laboratory	Reference	No.	5357	
		<b>FF</b>	~~~~~		110101010100	1.00		

cvo Sample ID	Client Sample JD	Date Collected	Time Collected	
535701	Feedwater	05/19/1997	10:40	
535702	Memcor Filtrate	05/19/1997	10:40	
535703	Zeeweed Permeate	05/19/1997	10:40	

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### CLIENT SAMPLE CROSS-REFERENCE

cvo Sample ID	Client Sample D	Date Collected	Time Collected
54670 <b>1</b>	FEEDWATER 3D	06/05/1997	9:38
546702	MEMCOR 3D	06/05/1997	14:40
546703	ZEEWEED 3D	06/05/1997	14:47

## CH2M HILL Applied Science Laboratory Reference No. 5467

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#### **CASE NARRATIVE** FORMATION POTENTIAL

Lab Reference No.: 5357

### Client/Project: City of McAllen

- L Holding Time: Holding time for this analysis is 24 hours. Holding time was exceeded upon arrival.
- IL <u>pH / Cl residual analysis:</u>
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - B. <u>Blanks</u>: All acceptance criteria were met.
  - C. <u>Other</u>. None
- IV. <u>Documentation Exceptions</u>: None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____ A. They Reviewed by: ______ Collins



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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5357

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#### Client/Project: City of McAllen

- I <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None

### III. Analysis:

- A. <u>ibration:</u> An acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- Matrix Spike Sample(s):
   All acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met
- F. <u>Other</u>. Not applicable.
- N. <u>Documentation Exceptions:</u> None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Kilen Van Nice</u>

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### CASE NARRATIVE DBPs

Lab Reference No.: 5467

Client/Project: City of McAllen

- I. <u>Holding Times</u>: HAA samples were extracted within holding times, but had high surrogate recoveries. HAA rextractions were performed 18 days after collection, holding time is 9 days.
- II. <u>Analysis</u>:
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - Blanks:
     All acceptance criteria were met.
  - C. <u>Duplicate Sample(s):</u> All acceptance criteria were met for HAA analysis. Not applicable for THM analysis.
  - D. <u>Spike Sample(s)</u>: All acceptance criteria were met except for trichloroacetic acid which had a spike recovery of 64%.
  - E. <u>Surrogate Recoveries:</u> All acceptance criteria were met except for 546701 which had a recovery of 134%, due to a surrogate interference.
  - F. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - G. <u>Other</u>: None
- III. <u>Documentation Exceptions</u>: None
- IV. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared by: _____ A. Hand . . . .

### CASE NARRATIVE DBPs

Lab Reference No.: 5467

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### Client/Project: City of McAllen

- I. <u>Holding Times:</u> HAA samples were extracted within holding times, but bad high surrogate recoveries. HAA rextractions were performed 18 days after collection, holding time is 9 days.
- II. <u>Analysis</u>:
  - A. <u>Calibration</u>: <u>All</u> acceptance criteria were met
  - B. <u>Blanks</u>: All acceptance criteria were met
  - C. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - D. Spike Sample(s):
     All acceptance criteria were met except for trichloroacetic acid (6/24/97) which had a spike recovery of 64%.
  - E. <u>Surrogate Recoveries:</u>
     All acceptance criteria were met for the 6/24/97 analysis except 546701 which bad a recovery of 134%, due to a surrogate interference.
  - F. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - G. | Other: None
- III. <u>Documentation Exceptions</u>: None
- IV. I certify that this dam package is in compliance with the terms and conditions agreed to by the client and CH2M HILL. both technically and for completeness, except for the conditions detailed above. Release of the dam containert in this hardcopy dam package has been authorized by the Laboratory Manager or designee. as verified by the following signature.

inger Collins Prepared by: Reviewed by:

y . . . . . . . •••

Project Manager Sampled By Sampling Date Sampling I-ii: Type Matrix:	: E. Perez ; 5/19/97	n al			Lab Information Laboratory ID: ICROR0 Date Rec'd: 5/20/97 Analytical Method: SM5310. Date Analyzed: 5/28/97 Report Revision No.: 0 Reported By: G. Collin Reviewed By: (///) Units: mg/L				
Client Sample ID	Lab Sample ID	рH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percentt RPD		
Feedwater	535701	2	0.50	6.8	7.0	<b>6</b> .9	29		
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U=Not detected/at s	pecified detection	on limits							

Applied Sciences Laboratory . Corvalis Office

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2300 NW Walnut Blvd., Corvatiis, OR 97330-3538 P.O. Box 428, Corvatiis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

Project Nam Project Nam Project Manage Sampled B Sampling Dat Sampling Tim Type Matri	e: Cii of McAllen er: Rosie Villarreal y: E. Perez e: \$/19/97	Laboratory	Lab Info Laboratory IE Date Reed Analytical Method Date Analyzed Report Revision No. Rewed By: Reviewed By	: ICROR001 I: 5/20/97 I: EPA 110.2 I: 5/21/97 : 0 H. Van Nice
Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) <b>Apparent</b> <b>Result</b>	Units
Feedwater	535701	5	10	Cobr Units
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Applied Sciences Laboratory2300 NW Walnut Blvd., Corvalis. OR 97330-3538Corvalis OfficeP.O. Box 428, Corvatis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

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Climit Information Project Name: o Project Manager: Sampled By: I Client Sampling Date: ( Sampling Time: Sampling Time: Matrix: v Matrix: v	lim Geisbush/I ). Hardy EEDWATER \$/5/97 3:38 3:ab 3:ab vater	Lab Information Date Rec'd: 6/5/97 Lab ID: 546701 Report Revision Na.: 1 Reported By: DAH Reviewed By: gmc Units: µg/L			
Basis: A	CAS #	<b>Reporting</b> Limit	Sampie Result	Qualifier [	) a te Analyzed
	<b>-</b>				
Haloacetic Acids - SM 6251. Inloroacetic add	В 79-11-Е	0.5	7.9		6104 IN7
<b>Bromoacetic</b> add	79-11-E 79-08-3	0.5	7.9 a.7		6/24/97 6/24/97
Sichloroacetic acid		0.5	a.7 28.4		•• = •• •
	7 <b>9-43-6</b> 76-03-s	0.5	20.4 15.8		6/24/97
Trichloroacetic acid	76-03-5 5589-95-3	0.5	15.0 34.4		6/24/97
Promochloroacetic acid		0.5	•		6/24/97
Dipromoacetic acid	631-64-1	0.5	26.3		6/24/97
23-Dibromopropanoic acid	600-05-5		134%	SS	
Inhalomethanes • EPA 502.2	2				
Chloroform	67-66-3	0.5	462		6/9/97
Eromodichloromethane	75-27-i	0.5	89.8		6/9/97
Dibromochloromethane	12448-I	0.5	130	E	6/9/97
Promotorm	75-25-Z	0.5	67.7		6/9/97
1,2-Dichloroethane-d4	17068-07-a		90%	SS	
	.,				
E=Exceeded instrument cali SS=Surrogate standard	bration range				

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Client Inference Ci Project Name: Ci Project Manager: Jir Sampled By: 0. Client Sample IO: M Sampling Date: 5/ Sampling lime: 14 Type: G Matrix: W Basis: As	n Geisbush/P Hardy EMCOR 3D 5/97 5:40 rab	Lab Information Date Rec'd: 6/5/97 Lab ID: 546702 Report Revision No.: 1 Reported By: QAH Reviewed By: QMC Units: µg/L				
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date <b>Analyzed</b>	
Haloacetic Acids - SM 6251.B Chloroacetic acid Bromoacetic acid Dichloroacetic acid Trichloroacetic acid Bromochloroacetic acid Dibromoacetic acid	79-11-8 79-08-3 79-43-6 76-03-9	0.5 0.5 0.5 0.5 0.5 0.5	6.6 10.7 38.3 13.3 41 <b>.8</b> 34.3		6/24/97 6/24/97 6/24/97 6/24/97 6/24/97 6/24/97	
2,3-Dibromopropanoic acid	<b>600-05-</b> 5		1 <b>22%</b>	SS		
<i>Trihalomethanes • EPA 502.2</i> Chloroform Bromodichloromethane Dibromochloromethane 124 Bromoform	<b>67-66-3</b> <b>75-27-4</b> - 4 8 - 1 75-25-Z	<b>0.5</b> 0.5 0.5 0.5	46.3 69.3 124 64.8	Ε	6/9/97 6/9/97 6/9/97 6/9/97	
1,2-Dichloroethane-d4	17068-07-0		93%	SS		
E=Exceeded instrument calibi	<b>ration</b> range					
SS=Surrogate standard U=Not detected at specified re	portina			រែក	nits	

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Cleaning Project Name: C Project Manager: J sampled By: ( Client Sample 10: 2 Sampling Oats: 6 Sampling Time: 1 Type: C Matrix: V Basis: As	im Geisbush/ b. Hardy ZEEWEED 30 V5/97 4:47 Grab	Lab Information Date Rec'd: 6/5/97 Lab ID: 546703 Report Revision No.: 1 Reported By: OAH Reviewed By: Gmc Units: µg/L					
Analyte	CAS #	Reporting Limit	Sample Result	Qualifier	Date Analyzed		
Haloacetic Acids - SM 6251.	S						
Chloroacetic acid	79-11-8	0.5	9.3		6/24/97		
Bromoacetic acid	79-08-3	0.5	12.2		6/24/97		
Dichloroacetic acid	7 <b>9-</b> 43-6	0.5	24.3		6/24/97		
Trichloroacetic add	76-03-9	0.5	16.4		6/24/97		
Bromochloroacetic acid	5589-96-3	0.5	34.1		6/24/97		
Dibromoacetic acid	631-64-1	0.5	293		6/24/97		
23-Dibromopropanoic acid	<b>600-05-</b> 5		104%	SS			
Trihalomethanes - EPA 502.2	,						
chloroform	67- <del>6</del> 6-3	0.5	36.9		6/9/97		
Bromodichloromethane	75-27-4	0.5	n.4		6/9/97		
Libromochioromethane	12446-I	0.5	113	E	6/9/97		
Bromotoru	76-26-Z	0.5	60.1	in in	6/9/97		
1,2-Dichioroethane-d4	17066-07-о		95%	SS			
E=Exceeded instrument calib	ration range						
\$S=Surrogate standard	-						
I=Not detected at specified	reporting limits	5			<u> </u>		

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CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

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Project Manage Sampled B Client Sample I Sampling Dat Sampling Tim Typ Matri	e: City of McAllen ar: Jim Geisbush/PH y: R. Villareal D: Feedwater te: 5/19/97	Lab Information Date Rec'd: 5/20/97 Lab iD: 535701 Analysis Method: SM 5710.D Report Revision No.: 0 Reported By: DAH Reviewed By:				
AA/THM Formation F Set-up Date/Time	Potential Test Conditi Target Contact Time	ions Initial pH	contact <u>p</u> H	Contact Temperature (°C)	<b>Chlorine</b> Dosage (mg/L)	
6/2/97 15:04	72:00	7.3	7.8	23	10.00	
inlorine Demand Test Take-off Date/Time	Results Contact Time		Measured pH	Measured Temperature (°C)	<b>Chlorine</b> Residual ( <b>mg/L</b> )	
6/5/97 9:38	66:34		7.6	23	1.12	
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This report has been expedited through our laboratory to meet your request. This data is classed Preliminary until you receive the hard copy report which has passed the ASL final review process.

Project Manage Sampled B Ctient Sample II Sampling Dat Sampling Tim Typ Matri	e: City of McAllen r: Jim Geisbush/PH y: R. Villareal D: Feedwater e: 5/19/97		Lab Information Date Rec'd: 5/20/97 Lab ID: 535701 Analysis Method: SM 5710.D Report Revision No.: 0 Reported By: DAH Reviewed By:					
HAA/THM Formation P Set-up Date/Time	otential Test Conditi Target Contact Time	ons Initial pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mo/L)			
6/2/97 15:04	72:00	7.3	7.8	23	10.00			
Chlorine Demand Test Take-off Date/Time	Results Contact Time		Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)			
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U=Not detected at spec	<b>ified</b> reporting <b>limits</b>	i						

This report has been expectited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

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### Corvallis Applied Sciences Laboratory

Clientinfactor	Labinet
Project Name: city of McAllen	Date Rec't: 5/20/97
Project Manager: Jim Geisbush/PHX	Lab ID: 535702
Sampled By: R. Villareal	Analysis Method: SM 5710.D
Client Sample ID: Memcor Filtrate	Report Revision No.: 0
Sampling Date: 5/19/97	Reported By: DAH
Sampling lime: 10:40	Reviewed By:
Type: Grab	-
Matrix: water	
Basis: As Received	

HAA/THM Formation Potential Test Conditions

 Set-up Date/Time	Target Contact Time	lnitlal pH	Contact pH	Contact Temperature (°C)	Chlorine Dosage (mg/L)
6/2/97 15:11	72:00	7.3	7.0	23	10.00

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Chlorine Demand Test Results

Take-off Date/Time	Contact Time	Measured pH	Measured Temperature (°C)	Chlorine Residual (mg/L)
6/5/97 14:40	71:29	7.7	23	1.72

U=Not detected at specified reporting limits

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Basis: As Received         W/THM Formation Potential Test Conditions         Contact       Contact       Temperal         Date/Time       Contact Time       pH       (*C)         6/2/97 15:19       72:00       8.0       7.8       23         Horine Demand Test Results       Measured       Measured       Measured         Take-off       Date/Time       0.0       7.6       23	ture Dosage (mg/L) 10.00 ed Chlorin ture Residua
Norine Demand Test Results Take-off Measured Temperat Date/Time Contact Time pH ("C)	ed Chlorin Ture Residua
Take-off         Measured         Temperat           Date/Time         Contact Time         pH         (*C)	ure Residua
<b>6/5/97 14:47</b> 71:28 7.6 23	<u>(mg/L)</u>
	0.44

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

Cilent Information         Project Name: city of Mc         Project Manager: Jim Geisb         Sampled By: D. Hardy         Client Sample ID: FEEDWA         Sampling Dam: 6/5/97         sampling Dam: 6/5/97         sampling Dam: 6/5/97         sampling Time: 9:38         Type: Grab         Matrix: Water         Basis: As Receiv         Analyte       CAS         Haloacetic Acids - SM 6251.B         Chloroacetic add       79-08-         Dichloroacetic add       79-43-         Trichloroacetic add       79-43-         Trichloroacetic acid       7589-91         Dibromoacetic acid       5589-92         Dibromoacetic acid       5589-93         Dibromoacetic acid       5589-94         Dibromoacetic acid       5589-95         Dibromoacetic acid       600-03         Trihalomethanes - EPA 502.2       Chloroform         Chloroform       67-66-         Bromodichloromethane       75-27-         Dibromochloromethane       12442-         Bromoform       75-25-         1,2-Dichloroethane-d4       17068-0	ush/PHX TER 3D ed <b>Reporting</b> <b>± Limit</b> S 0.5 3 0.5 6 0.6 9 0.5 5-3 0.5 5-3 0.5 5-5 5-5 5-5 5-5 3 0.5 -1 0.5 5-5 5-5 2 0.5	Report	b Information Date Rec'd: Lab ID Revision No.: Reported By: Reviewed By: Units: Qualifier	6/5/97 546701 0 DAH μg/L Date Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Project Manager: Jim Geisb Sampled By: D. Hardy Client Sample ID: FEEDWA Sampling Dam: 6/5/97 sampling Time: 9:38 Type: Grab Matrix: Water Basis: As Receiv         Analyte       CAS         Haloacetic Acids - SM 6251.B         Chloroacetic add       79-11- Bromoacetic acid         Bromoacetic acid       79-08- Dichloroacetic acid         Dichloroacetic acid       76-03- Stromochloroacetic acid         Bromochloroacetic acid       5589-91 Dibromoacetic acid         Jibromoacetic acid       5589-92 Dibromoacetic acid         Chloroform       67-66- Stromodichloromethane         Trihalomethanes - EPA 502.2       Chloroform         Chloroform       67-66- Bromodichloromethane         Tribalomethanes - EPA 502.2       Chloroform         Chloroform       67-66- Bromodichloromethane         Tribalomethanes - EPA 502.2       Chloroform         Chloroform       67-66- Bromodichloromethane         Tribalomethanes - EPA 502.2       Chloroform         Chloroform       75-25-	ush/PHX TER 3D ed <b>Reporting</b> <b>± Limit</b> S 0.5 3 0.5 6 0.6 9 0.5 5-3 0.5 5-3 0.5 5-5 5-5 5-5 5-5 3 0.5 -1 0.5 5-5 5-5 2 0.5	<b>Sample</b> <b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30.5</b> 194% 46.2 69.6	Lab ID Revision No.: Reported By: Reviewed By: Units: Qualifier	546701 0 DAH pg/L <b>Date</b> Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Sampled By: D. Hardy Client Sample ID: FEEDWA Sampling Dam: 6/5/97 sampling Time: 9:38 Type: Grab Matrix: Water Basis: As Receiv Analyte CAS Haloacetic Acids - SM 6251.B Chloroacetic add 79-08- Dichloroacetic add 79-08- Dichloroacetic add 79-08- Dichloroacetic add 79-43- Trichloroacetic add 79-43- Trichloroacetic add 79-43- Trichloroacetic add 76-03- Bromochloroacetic acid 5589-99 Dibromoacetic acid 631-64 2,3-Dibromopropanoic a c i d 600-03 Trihalomethanes - EPA 502.2 Chloroform 67-66- Bromodichloromethane 75-27- Dibromochloromethane 124422 Bromoform 75-25-	TER 3D         ed         Reporting         #       Limit         S       0.5         3       0.5         6       0.6         9       0.5         5-3       0.5         -1       0.5         5-5       0.5         3       0.5         -1       0.5         2       0.5	<b>Sample</b> <b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30.5</b> 194% 46.2 69.6	Revision No.: Reported By: Reviewed By: Units: Qualifier	0 DAH pg/L Date Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Client Sample ID: FEEDWA         Sampling Dam: 6/5/97         sampling Time: 9:38         Type: Grab         Matrix: Water         Basis: As Receiv         Analyte         CAS         Haloacetic Acids - SM 6251.B         Chloroacetic add         79-08-         Dichloroacetic acid         79-08-         Dichloroacetic acid         79-08-         Dichloroacetic acid         76-03-         Bromochloroacetic acid         5589-91         Dibromoacetic acid         631-64         2.3-Dibromopropanoic a c i d         600-02         Trihalomethanes - EPA 502.2         Chloroform         67-66-         Bromodichloromethane         75-25-         Dibromochloromethane         124422         Bromoform         75-25-	ed <b>Reporting</b> <b>Limit</b> S 0.5 3 0.5 6 0.6 9 0.5 5-3 0.5 5-5 5-5 3 0.5 -1 0.5 5-5 3 0.5 -1 0.5 -1 0.5 -2 0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6	Reviewed By: Units: Qualifier	2 μg/L Date Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
sampling Time: 9:38Type: GrabMatrix: WaterBasis: As ReceivAnalyteCASHaloacetic Acids - SM 6251.BChloroacetic addChloroacetic add79-08-Dichloroacetic add79-43-Trichloroacetic add79-43-Trichloroacetic add79-43-Dichloroacetic add79-43-Dichloroacetic add79-43-Dichloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2Chloroform67-66-Bromodichloromethane75-25-Bromoform75-25-	Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6	Reviewed By: Units: Qualifier	2 μg/L Date Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
sampling Time: 9:38Type: GrabMatrix: WaterBasis: As ReceivAnalyteCASHaloacetic Acids - SM 6251.BChloroacetic addChloroacetic add79-08-Dichloroacetic add79-43-Trichloroacetic add79-43-Trichloroacetic add79-43-Dichloroacetic add79-43-Dichloroacetic add79-43-Dichloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2Chloroform67-66-Bromodichloromethane75-25-Bromoform75-25-	Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6	Qualifier	Date Analyze 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Matrix: Water Basis: As ReceivAnalyteCASHaloacetic Acids - SM 6251.BChloroacetic add79-11-Bromoacetic add79-08-Dichloroacetic add79-43-Trichloroacetic add76-03-Bromochloroacetic acid5589-94Dibromoacetic acid5589-94Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-25-Dibromochloromethane124422Bromoform75-25-	Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6		6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Basis: As ReceivAnalyteCASHaloacetic Acids - SM 6251.BChloroacetic addChloroacetic addPomoacetic acidPomoacetic acidPomoacetic acidTrichloroacetic acidStomochloroacetic acidStomochloroacetic acidStomochloroacetic acidStomochloroacetic acidChloroformChloroformChloroformStomochloromethaneTrihalomethanes - EPA 502.2ChloroformChloroformStomochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneChloroformChloroformChloroformTobromochloromethaneTobromochloromethaneTobromochloromethaneTobromochloromethaneChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroformChloroform <th>Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5</th> <th><b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b>.5 194% 46.2 69.6</th> <th></th> <th>6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97</th>	Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6		6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
AnalyteCASHaloacetic Acids - SM 6251.BChloroacetic AcidChloroacetic AcidBromoacetic acidOichloroacetic acidTrichloroacetic acidFromochloroacetic acidStromochloroacetic acidSibromoacetic acidChloroformChloroformChloroformFormodichloromethaneTrihalomethanes - EPA 502.2ChloroformChloroformStromodichloromethane75-25-	Reporting           Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6		6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Haloacetic Acids - SM 6251.B         Chloroacetic add       79-11-         Bromoacetic acid       79-08-         Dichloroacetic acid       79-43-         Trichloroacetic acid       76-03-         Bromochloroacetic acid       5589-94         Dibromoacetic acid       631-64         2,3-Dibromopropanoic a c i d       600-03         Trihalomethanes - EPA 502.2       Chloroform         Chloroform       67-66-         Bromodichloromethane       75-25-         Bromoform       75-25-	Limit           S         0.5           3         0.5           6         0.6           9         0.5           5-3         0.5           -1         0.5           5-5         0.5           3         0.5           -1         0.5           5-5         0.5           2         0.5	<b>Result</b> 5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30</b> .5 194% 46.2 69.6		6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Haloacetic Acids - SM 6251.B         Chloroacetic add       79-11-         Bromoacetic acid       79-08-         Dichloroacetic acid       79-43-         Trichloroacetic acid       76-03-         Bromochloroacetic acid       5589-94         Dibromoacetic acid       631-64         2,3-Dibromopropanoic a c i d       600-03         Trihalomethanes - EPA 502.2       Chloroform         Chloroform       67-66-         Bromodichloromethane       75-25-         Bromoform       75-25-	S 0.5 3 0.5 6 0.6 9 0.5 5-3 0.5 -1 0.5 5-5 3 0.5 4 0.5 -1 0.5 -1 0.5 -2 0.5	5 . 5 <b>8.6</b> 29.1 13.9 39.6 <b>30.5</b> 194% 46.2 69.6		6/10/97 6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Chloroacetic add79-11-Bromoacetic acid79-08-Dichloroacetic add79-43-Trichloroacetic acid76-03-Bromochloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	3       0.5         6       0.6         9       0.5         5-3       0.5        1       0.5         5-5      1         3       0.5         -4       0.5         -1       0.5         -2       0.5	8.6 29.1 13.9 39.6 30.5 194% 46.2 69.6	SS	6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Chloroacetic add79-11-Bromoacetic acid79-08-Dichloroacetic add79-43-Trichloroacetic acid76-03-Bromochloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	3       0.5         6       0.6         9       0.5         5-3       0.5        1       0.5         5-5      1         3       0.5         -4       0.5         -1       0.5         -2       0.5	8.6 29.1 13.9 39.6 30.5 194% 46.2 69.6	SS	6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Bromoacetic acid79-08-Dichloroacetic acid79-43-Trichloroacetic acid76-03-Bromochloroacetic acid5589-94Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	3       0.5         6       0.6         9       0.5         5-3       0.5        1       0.5         5-5      1         3       0.5         -4       0.5         -1       0.5         -2       0.5	29.1 13.9 39.6 <b>30.5</b> 194% 46.2 69.6	SS	6/10/97 6/10/97 6/10/97 6/10/97 6/10/97
Dichloroacetic add79-43-Trichloroacetic acid76-03-Bromochloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	9 0.5 5-3 0.5 -1 0.5 5-5 3 0.5 4 0.5 -1 0.5 -1 0.5 -2 0.5	29.1 13.9 39.6 <b>30.5</b> 194% 46.2 69.6	SS	6/10/97 6/10/97 6/10/97 6/10/97
Trichloroacetic acid76-03-Bromochloroacetic acid5589-91Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	9 0.5 5-3 0.5 -1 0.5 5-5 3 0.5 4 0.5 -1 0.5 -2 0.5	39.6 30.5 194% 46.2 69.6	SS	6/10/97 6/10/97 6/10/97
Bromochloroacetic acid5589-94Dibromoacetic acid631-642,3-Dibromopropanoic a c i d600-03Trihalomethanes - EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	5-3 0.5 -I 0.5 5-5 3 0.5 4 0.5 -I 0.5 -2 0.5	30.5 194% 46.2 69.6	SS	6/10/97 6/10/97 6/9/97
Dibromoacetic acid631-642.3-Dibromopropanoic a c i d600-03Trihalomethanes • EPA 502.2ChloroformChloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	I 0.5 5-5 3 0.5 -4 0.5 -1 0.5 -2 0.5	194% 46.2 69.6	SS	6/10/97
Trinalomethanes - EPA 502.2Chioroform67-66-Bromodichioromethane75-27-Dibromochloromethane12442-Bromoform75-25-	3 0.5 4 0.5 -1 0.5 -2 0.5	46.2 69.6	SS	
Chloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	4 0.5 -1 0.5 -2 0.5	69.6		
Chloroform67-66-Bromodichloromethane75-27-Dibromochloromethane12442-Bromoform75-25-	4 0.5 -1 0.5 -2 0.5	69.6		
Dibromochloromethane 12442 Bromoform 75-25-	-1 <b>0.5</b> -2 0.5			
Bromofarm 75-25-	2 0.5	130		6/9/97
			E	6/9/97
1,2-Dichloroethane-d4 17068-0		67.7		6/9/97
	7-0	90%	SS	
E=Exceeded instrument calibration rai SS=Surrogate standard	nge			

This report has been expedited through our laboratory to meet your request. This data is classed *Preliminary* until you receive the hard copy report which has passed the ASL final review process.

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Corvallis Applied S	ciences L	aboratory	1					
Client_Information	<b>.</b>		Lab					
	City of McAllen			Date Rec'd:				
Project Manager:		PHX	Lab ID: 546702					
Sampled By:	-			Revision No.:				
Client Sample ID:				Reported By				
sampling Dam:			F	Reviewed By:	1			
Sampling Time:				Units:	µg/L			
Туре:								
Matrix:					1			
Basis	As Received							
		Reporting	Sample					
Analyte	CAS #	Limit	Result	Qualifier	Date Analyzed			
	-							
Haloacetic Acids - SM 6251.								
Chloroacetic acid	Toll-6	0.5	6.4	•	6/10/97			
Bomoacetic add	79-08-3	05	9.4		6/10/97			
Dichloroacetic acid	79-43-6	0.5	30.3		6/10/97			
Trichicroacetic acid	76-03-9	0.5	6.2		6/10/97			
Bromochloroacetic acid	55 <b>89-96</b> -3	0.5	41.4	E	6/10/97			
Dibromoacetic acid	<b>631-64-</b> 1	0.5	34.9		6/10/97			
			4070/					
2.3-Dibromopropanoic a d	a <b>600-05-5</b>		107%	SS				
Trihalomethanes - EPA 502	2							
Chioroform	67-66-3	0.5	46.3		6/9/97			
Bomodichloromethane	75-27-4	0.5	66.3		6/9/97			
Dibromochloromethane	12446-I	0.5	124	Е	6/9/97			
Bromoform	75-25-2	0.5	64.6	<b>-</b>	6/9/97			
		0.0	0410					
1.2-Dichloroethane-d4	17068-07-0		63%	SS				
					·			
	• :	-						
E=Exceeded instrument cal	ibration range							
	in anon ange							
SS=Surrogate standard U=Not detected at specified	monting limite							

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This report has been expedited through our laboratory to meet your request. This data is classed. Preliminary until you receive the hard copy report which has passed the ASL final review process.

Corvallis Applied S	Sciences L	aboratory	/					
				1-4 11				
Cilesiant Name	e:CityOf McAller							
Project Manager:			Dam <b>Rec'd:6/5/97</b>					
Sampled By:			Lab ID: 546703 Report Revision No.: 0					
Client Sample ID:				Reported By:				
Sampling Date:				Reviewed By:				
Sampling lime:			•	Units:				
Type:				01463.	, pyr			
Matrix:								
Basis:	As Received							
		Reporting	Sample		-			
Analyte	CAS #	Limit	Result	Qualifier	Date Analyzed			
<u></u>			( losoft	dudinici	Date Analyzed			
Haloacetic Adds - SM 6251	.B							
Chloroacetic acid	79-11-8	0.5	7.	4	6/10/97			
Bromoacetic acid	79-08-3	0.5	13.8		6/10/97			
Dichloroacetic acid	7943-a	0.5	25.8		6/10/97			
Trichloroacetic acid	76-03-9	0.5	124		6/10/97			
Bromochioroacetic acid	5589-96-3	0.5	36.4		6/10/97			
Dibromoacetic acid	631-w-l	0.5	31.2		6/10/97			
2,3-Dibromopropanoic acid	600-05-5		104%	SS				
Trihalomethanes • EPA 502	2							
Chloroform	- 67-66-3	0.5	38.9		6/9/97			
Bromodichloromethane	75-27-4	0.5	i7.4		6/9/97			
Dibromochloromethane	124-48-I	0.5	113	E	6/9/97			
Bromoform	75-25-2	0.5	60.1		6/9/97			
1,2-Dichloroethane-d4	17068-07-0		95%	SS				
	· · · ·	<del>.</del>						
E=Exceeded instrument cali	bration range							
SS=Surrogate standard								
U=Not detected at specified	monorting I	:	m	:	+ e			

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This report has been expedited through our laboratory to meet your request. This data is classed Preliminary until you receive the hard copy report which has passed the ASL final review process.

## MONTHLY BILLING SUMMARY

**Applied Sciences Laboratory** CH2MHILL Corvailis, Oregon 2300 NW Walmut Elvd, Corvailis, OR 97330-3538 P.O. Box 428, Corvailis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Project Manager: Jim Geisbush/PHX

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Invoice Date 06/06/97 Invoice No. A97-1013

Page 1 of I

Customer Number 138067.A0.ZZ	<b>CH2M</b> Hill Rep. Doug Hardy	Billing Pe <b>7/9/9</b>		ference No. 5467
Qty Descript	CU	Trans. Date	Unit Cost	Subtotal
3 Haloacetic Acids 3 Trihalomethanes by Purge & Trap		6/5/97 6/5/97	\$225.00 \$75.00	
(THIS IS NOT A BILL	DO NOT SUBMIT PAYMEN	7) TOTAL	AMOUNT:	\$900.00

Our records indicate that, the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.



## MONTHLY BILLING SUMMARY



## Applied Sciences Laboratory

Corvailis, Oregon 2300 NW Wainut Blvd. Corvallis. OR 97330-3538 P.O. Box 428, Corvallis. OR 97339-0428 541 752-4271 Fax 541 752-0275

City of McAllen Project Manager: Jim Geisbush/PHX

Invoice Date 05/20/97 Invoice No. A97-0887

Page 1 of 1

-	ustomer Number 138067_A0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Pe <b>7/9/97</b>		erence No. 5357
Qty	Description		Trans. Date	Unit Cast	Subtotal
1 3	Color (ALPHA) Apparent Trihalomethane 8 Haloacetic Acids For (THM/HAAFP): pH, temperature. chlorine time set at desired test conditions		5/20/97 5/20/97	\$20.00 \$135.00	\$20.00 \$405.00
1	Total Organic Carbon (EPA 415.1)		5/20/97	\$40.00	\$40.00
	(THIS IS NOT A BILL -DO N	OT SUBMIT PAYMENT	TOTAL	AMOUM:	\$465.00

Our records indicate that the above **tests** were requested during the current billing period. Please notify the **laboratory** listed above if there are any discrepancies.

1 1

- PROJECT COPY -

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### - RECEIVED =

JUN 30 1997

CH2M HILL 2300 NW Wainut Bivd, Corvalis, OR 97330-3538 Mailing address: P.O. Box 428 Corvalis, OR 97339-0428 Tel 541.752.4271 Fex 541.752.4276

CH2M HILL/PHOENIX

6/25/97

City of McAllen

Subject: Acknowledgment of sample set 5607.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 6/24/97. It has been assigned laboratory number 5607. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Jew Warthick

Jerri Mattick

Attachment

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CH2MHICT Ana Indical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES LING 2507 Fairlane Drive Monigomery, AL 36118-1622 (324) 271-1444 FAX (334) 271-3428 ARD 5090 Cateronia Road Redding, CA198003-1412 (916) 244-5227 FAX (916) 244-4109 DLKW Canviro Analytical Laboratories, Inc. 50 Bathurat, Unit 12, Waterloo, Cintario, Canada N2V 2C5 (519) 747-2575 FAX (519) 747-3806 CICV0 2300 NW Wilkilk Boulevard Corvalks, DR 97330-3636 (541) 752-4271 FAX (541) 752-0276 COC# Project # Purchase Order # Requested Analytical Method # THIS AREA FOR LAB USE ONLY ۰. Ξł. SCETHE 21 7 **b**. Lab # Page oł Project Name ۲ 5/07-173 à Z v Ŧ McAllen - No3 hes thore ab PM ٨ **Custody Review Company Nama** . よう MiAllen Public ic.S 22 0 Project Manager or Contact & Phone # **Report Copy to:** Log In LINS Verification Ē. RONE V. HORASHI D <u>Phoenix</u> lin heisbush 4 <u>з</u> 210-631-8340 1 ō Requested Completion Date: | Sile ID Sample Disposal: * N ъH Custody Seals Y N F Return Ice Y N ASAP NW10 Ho 'n 1 Preservative -N E Matrix QC Level 1 2 Other Tipe 47 <u>.</u> A ð . . . . .... W B A A O I T I R 8 ĉ A. 1 Gampling CLIENT SAMPLE ID LAB Cooler Temperature S . ł ARACTERS) ¥. QC 1 1945.94 N ţ Ê ٢ Time? -1 <u>_</u>___ Date Alternate Description Lab ID 1/2/1 2 ٠Ť 1.43 11 30 đ 2 AWATER ā ł 62337 10.40 seé Hwla‡ e. . . L 4/2367 19410 Permedi Zekwiesi 1 1 6/15/3 12:40 2 denied ler medt Perments ì. 240 612#17.10:49 Ì utid 1 Filtfrate Menteole 2 64242 12:40 ~ mencosfiltate 6/11/97 1.0210 . Manche Filttrate 62347 10:40 V . DataTina BJ47 Empty Bottles **Relinguished By** Date/Time Myr Received/By Emply Bollies baterTimer . Reingylaned By Hone Villeria  $\boldsymbol{a}$ Q.44 28 A M. 1 Please sign and print name) (Please sign and print name) Dele/Time 101 nui WX hilsenal ଇ Escul <u>schut</u>. Jachie 16 123 **Ascelved By** Dele/Time A ... Relinguished By (Please sign and print name) (Pluase sign and print name) Date/Time P Prove vallerig Rosa V. Harman 123/92 10:50 Konio V ittermort Vere Viller 14 . W. W. **Received By** (Please sign and print name) Date/Time Shipped Vig Shipping # Fed-Ex TOther UPS **Special Instructions:** Curtant Ginger

APP-169

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CH2M HILL 2300 NW Warnut Blvd. Corvatiis, OR 97330-3538 Maxing address: P.O. Box 428 Corvatis, OR 97339-0428 Tei 541.752.4271 Fex 541.752.6276

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06/23/97

City of McAllen

Subject Acknowledgment of sample set 5557.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 6/23/97. It has been assigned laboratory number 5597. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were ao problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Jewi Macthik

Jerri Mattick

Attachment

CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES	LMB 2567 Fablar Monigomery, AL 361 (334) 271-1444 FA3	18-1622 ( (334) 20 (-3	1   1428	CILRD 5090 Redding, CA (916) 244-52	Culerpillar 96403-141 7 FAX (9	Road 2 16) 244-4	f 1	01 Cal 1 diwet, 1) 747-25	viro Analytical Unil 12, Water 75 FAX (519	Laboratori Ioo, Ontari 747-3806	o, Canada N2V 2C5 Corvul	2300 NW Walnu s, OR 97330-36 2 4271 FAX (54 #	38
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CH2M HBLL 2200 NW Walnut Blvn. Corvatiis, OR 97330-3538 Mailing address: P.O. Box 428 Corvatia, OR 97339-0425 Tel 541.752.4271 Fex 541.752.0276

June 10.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5468

### Jim Geisbush/PHX

On June 6.1997, the CH2M HILL. Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case namarive.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely.

Mufinaer

Kelly **Ensor** Senior Administrative Assistant

Enclosures

Corvatis Óffica

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 P. O. Box 428, Corvalis, OR 97339-0428

541 752-4271 Fex No. 541 752-0276

### CLIENT SAMPLE CROSS-REFERENCE

### CH2M HILL Applied Science Laboratory Reference No. 5468

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
	_		
546801 546802	Memcor Filtrate Zeeweed Permeate	06/05/1997 06/05/1997	9:30 9:30

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#### **CASE** NARRATIVE **GENERAL** CHEMISTRY

Lab Reference No.: 5468

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### Client/Project: City of McAllen

- I. Holding lime: All acceptance criteria were met.
- Π. Digestion Exceptions: None
- Ш. Analysis:
  - Calibration: A. All acceptance criteria were met.
  - ₿. Blanks: All acceptance criteria were met.
  - С. Matrix Spike Sample(s): All acceptance criteria were met.
  - Duplicate Sample(s): D. All acceptance criteria were met.
  - E. Lab Control Sample(s): The panel observed a 20 Color Unit standard as 15 Color Units. Other acceptance criteria were met.
  - F. Other: Nor applicable.
- N. Documentation Exceptions: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

inger Ollin 1 Ven Mice Reviewed by:

2 - 2 - 2 .

Project Manager Sampled By Sampling Date: Sampling Time: Type: Matrix:	: E. Perez 6/5/97				Lat Analytic Date Report Re R	Lab Information Date Rec'd: 6 cal Method: S e Analyzed: 6 evision No.: 0 eported By: 0 eviewed By: 1 Units: 1	CROR001 516197 5M5310.D 5/9/97 ) G. Collins
Client Sample ID	Lab Sample ID	pН	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Memcor Filtrate Zeeweed Permeate	546801 546802	22 22	0.50	6.9 6.8	6.9 6.7	6.9 6.7	0.0

Applied Sciences Laboratory . Corvallis Office

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2300 NW Wainut Elvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-6428 (541) 752-4271 Fax No.(541) 752-0276

Project Manager Sampled By: Sampling Dale: Sampling lime: Type: Matrix:	E. Perez 6/5/97 930 Grab		Lab Information Laboratory ID: ICROR001 Date Rec'd: 6/6/97 Analytical Method: EPA 110.2 Date Analyzed: 6/6/97 Report Revision No.: 0 Reported By: H. Van Nice Reviewed By: M.				
<b>Client</b> Sample ID	lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units			
MemcorFiltrate ZeeweedPermean	546901 te <b>546802</b>	5 5	v. 5 10	Color Units Color Units			

Applied Sciences Laboratory Corvallis Office

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.C. Box 428, Corvailis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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#### CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

l ILMG 2567 Fairlane Drive Monigonwy, AL 38116-1622 (334) 271-1444 - FAX (334) 271-3428

i ilan 5090 Caterpillar Road Reduing, CA 86003-1412 (916) 244-5227 FAX (916) 244-4109

| | | KW Carwiro Analysical Laboratorias, Inc. 80 Bathurat, Unit 12, Waterkoo, Ontario, Canada N2V 2C5 (519) 747-2575 | FAX (519) 747-3800

1 1CVD 2300 NW Watnut Boulevard Corvalis, OR 97330 3638 (541) 752 4274 FAX (541) 752 0276

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## MONTHLY BILLING SUMMARY

Applied Sciences Laboratory CH2MHILL Corvalis, Oregon 2300 NW Walnut Blvd. Corvalis, OR 97330-3538 P.O. Box 428, Corvalis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Project Manager: Jim Geisbush/PHX

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Invoice Date 06/06/97 Invoice No. A97-1017

Page 1 Of 1

	ustomer Number <b>38067.A0.ZZ</b>		CH2M Hill Rep. Ginger Collins	Billing Per 6/11/9		Reference No. 5468		
Qty		Description		Trans. Date	Unit Cost	Subtetal		
2 2		Apparent rbon		6/6/97 6/6/97	\$20.00 \$40.00	<b>\$40.00</b> \$80.00		
	(THIS	IS NOT A BILL - DO	NOT SUBMIT PAYMENT	7 TOTAL	AMOUNT:	\$120.00		

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

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APP-178

.... PROJECT COPY ---

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CH2M HILL 2300 NW Wainut Bivo. Gorvalis, QR 97330-3538 Maining address: P.O. Box 428 Corvalis, CR 97339-0428 Tel 541.752,4271 Fex 541.752,0276

6/6/97

City of McAllen

Subject Acknowledgment of sample set 5468.

### Dear Jii Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set 0" 6/6/97. It has been assigned laboratory number 5468. Please refer to the laboratory number if you need to inquire about this sample set I have attached a copy of the chain of custody form to provide additional information.

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There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Jew Mastrik

Jerri Mattick

Attachment

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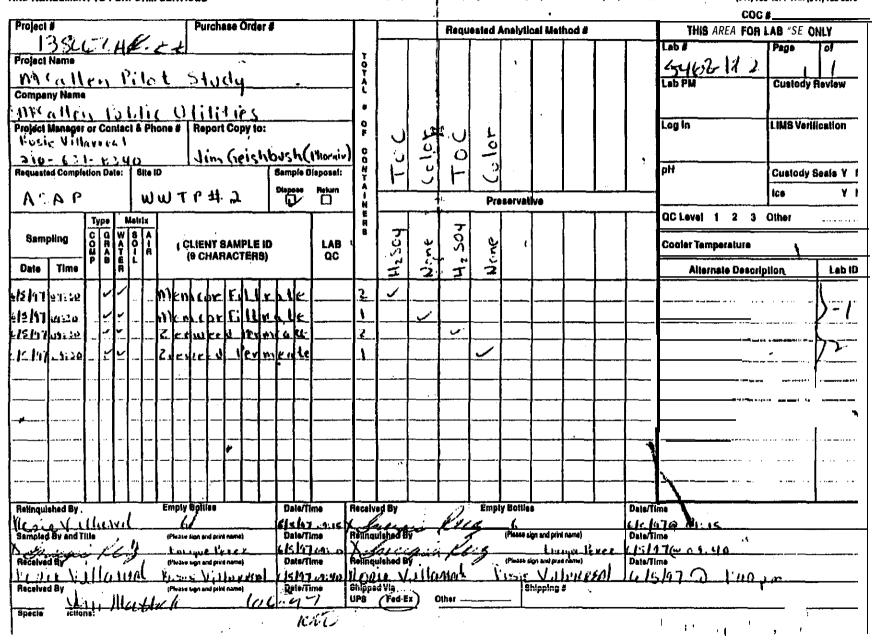
# CH2MHICL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LUIB 2567 Faklane Drive Monigomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

140 6000 galarpilar Road Redding, CA 90003-1412 (918) #44-522] FAX (918) 244-4109

LKW Cenviro Analytical Laboratories, Inc. 50 Bathwel, Unit 12, Walerloo, Ontario, Canada N2V 2C5 (\$19) 747-2575 FAX (\$19) 747-3806

L.JCV0 2300 NW Walitut Boulevard Corvalia, DB 97330-3638 (541) 752-4271 FAX (541) 752-0276





CH2M HILL 2300 NW Walnut Blvd. Corvallis, OR 97330-3538 Maning address: P.O. Box 428 Corvallis, CR 97339-0428 Tel 541.752.4271 Fex 541,752,0276

June 5.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5416

### Jim Geisbush/PHX

On May 30, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical results and associated quality control data arc enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235. extension 3120.

Sincerely,

Willignow

Kelly Ensor Senior Administrative Assistant

Enclosures

Carvallis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P O Roy 428 Convallis, OP 97330-4528 P. O. Box 428, Corvalis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

## CH2M HILL Applied Science Laboratory Reference No. 5416

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
541601	Feedwater	05/29/1997	9:00

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### CASE NARRATIVE GENERAL **CHEMISTRY**

Lab Reference No.: 5416

Client/Project: City of McAllen

- L <u>Holding Time:</u> All acceptance criteria were met.
- a <u>Digestion Exceptions</u>: None
- III. Analysis:
  - A . <u>Calibration</u>: All acceptance criteria were met.
  - B. Blanks: All acceptance criteria were met.
  - C. <u>Marrix Spike Sample(s)</u>: Not applicable.
  - D . <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: The panel observed a 20 color unit standard as 15 color Units. Other acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- lv. Documentation Exceptions: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Aunger Collins</u> 6/5/97 Reviewed by: <u>Helen Van Nece</u> 6/5/97

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Project Manage sampled By: sampling Date Sampling lime Type Matrio	City of McAlle Rosie Villarrea E. Perez e: 5/29/97	n	aboratory		Analyti Date Report Re R(	Lab Inform boratory ID: Date Rec'd: cal Method: e Analyzed: vision No.: ( eported By: viewed By: Units:	ICROR001 5/30/97 SM5310.D 6/2/97 G. Collins
Cilent Sample ID	Lab Scmple ID	рH	Reporting Limil	Replicate 1	TOC water Replicate 2	Average	Percent RPD
Feedwater		-22	1.0	6.9	6.9	6.9	0.0

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P.O. Bax 428, Corvallis, OR 97339-0428

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(541) 752-4271 Fax No.(541) 752-0276

Project Manager Sampled By: Sampling Date: Sampling lime: Type: Matrix:	City of McAllen Rosie Villarreal E. Perez 5/29/97 9:00 Grab	Laboratory	Laboratory II Date Rec' Analytical Metho Date Analyzed Report Revision No	<b>1: 5/30/97</b> 5.: 0 y: H. Van <b>Nice</b>
Client Sample ID	Lab Somple ID	Reporting Limit	Color (ALPHA) Apparent <b>Result</b>	Units
Feedwater	641601 ecified detection limi	īts	5 ប	Color Units

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Applied Sciences Laboratory Corvallis Office ·..

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Sox 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

#### CH2MIHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LIMB 2567 Faktane Drive Monigomery, AL 36118-1622 (334) 271-1444 FAX (334) 271-3428

DLRD 5090 Caterpillar Road Redding, CA 98003-1412 (916) 244-5227 FAX (918) 244-4109

 LIKW Canviro Analytical Laboratories, Inc. 60 Bathurel, Unit 12, Waterloo, Ontario, Canada N2V 2C5 (519) 747-2575 FAX (519) 747-3808

Corvalls, OR 9731 (641) 752 4271 FA

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## MONTHLY BILLING SUMMARY



Applied Sciences Laboratory Corvallis, Oregon 2300 NW Wainus Blvd. Convalis, OF 97330-3538 P.O. Box 428, Convalis, OR 97339-0428 541 752-4271 Fax 541 752-0276

### City of McAllen

Project Manager: Jim Geisbush/PHX

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Invoice Date 06/02/97 Invoice No. A97-0968

Page 1 of 1

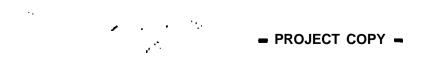
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Customer Number	CH2M Hill Rep.	Billing Period	Reference No. 5416
138067.A0.ZZ	Ginger Collins	6/1 1/97	

Qty	Description	Trans. Date	Unit Cost	Subtotal
1	Color (ALPHA) Apparent	5/30/97	\$20.00	\$20.00
1	Total Organic Carbon	5/30/97	\$40.00	\$40.00
	(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT)	TOTAL	AMOUNT:	\$60.00

(THIS IS NOT A BILL - DO NOT SUBMIT PAYMENT) TOTAL AMOUNT:

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.



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CH2M HILL 2300 NW Warnu: Blva. Corvatiis, OR 97330-3538 Masiing address: P.O. Box 428 Corvatiis, CR 97339-0428 Tet 541.752.4271 Fex 541.752.0276

6/4/97

City of McAllen

Subject: Acknowledgment of sample set 5440.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 6/3/97. It has been assigned laboratory number 5440. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

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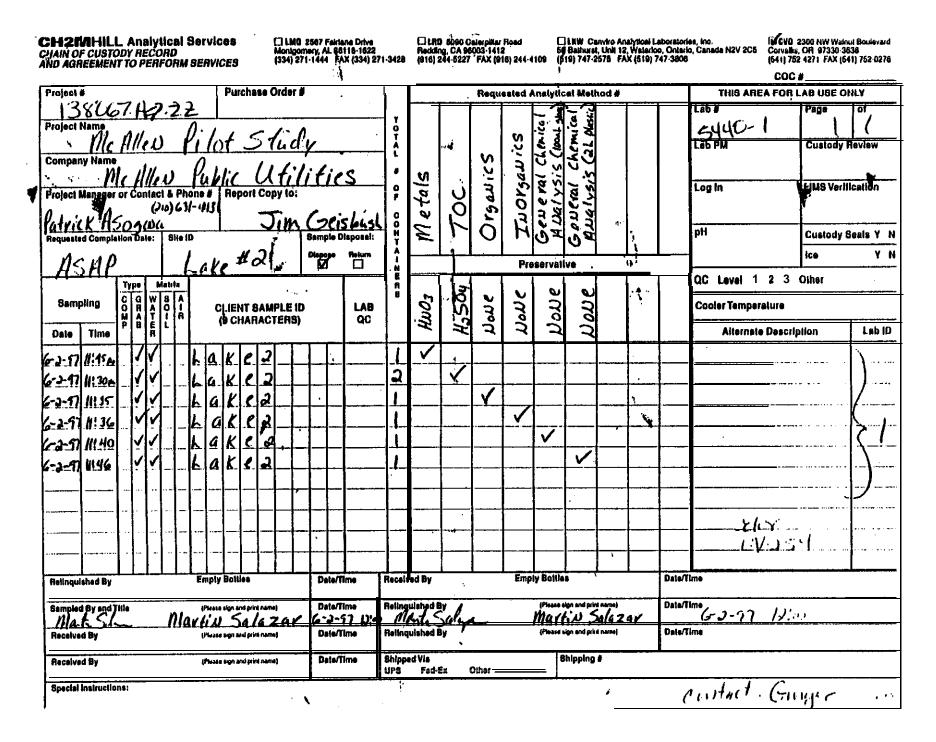
Sincerely, CH2M HILL

Jew. Martick

Jerri Mattick

Attachment





APP-189



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C		

CH2M HILL 2300 NW Walnut Siva. Corvatis. OR 97330-3538 Mabing address: P.O. Box 428 Corvatis. OR 97339-0428 Tel 541.752.4271 Fex 541.752.4275

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6/2/97

City of McAllen

Subject: Acknowledgment of sample set 5416.

Dear Jim Geisbush/PHX:

This letter is m acknowledge the receipt of your sample set on 5/30/97. It has been assigned laboratory number 5416. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form m provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Ven Martick

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Jerri Mattick

Attachment

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CH2M HILL 2300 NW Walnut Blvc Corvatis, OR 97330-3538 Mailing address: P.O. Box 428 Corvatiis, OR 97339-0428 Tel 541.752.4271 Fex 541.752.0275

May 30, 1997

Cii of McAllen

138067.A0.ZZ

RE: Analytical Dam for City of McAllen CVO Laboratory Reference No. 5383 Jim Geisbush/PHX

On May 23.1997, the **CH2M HILL Corvallis** Applied Sciences **Laboratory** received two samples with a request for **analysis** of **selected parameters**.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case namative.

Under **CH2M** HILL policy, your **samples** will **be** scored for 30 days **after** reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M** HILL. Applied Sciences **Laboratory appreciates** your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Willefran

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvallis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 P. O. Box 428, Corvallis. OR 97339-0428

541 752-4271 Fax No. 541 752-0276

**APP-192** 

## **CLIENT** SAMPLE CROSS-REFERENCE

## CH2M HILL Applied Science Laboratory Reference No. 5383

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
538301	MEMCOR Filtrate	05/22/1997	8:45
538302	ZEEWEED Permeate	05/22/1997	8:45



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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5383

### Client/Project: City of McAllen

- L Holding Time: All acceptance criteria were met.
- Π. Digestion Exceptions: None
- Ш. Analysis:
  - Calibration: Α. All acceptance criteria were met.
  - В. Blanks: All acceptance criteria were met.
  - C. Matrix Spike Sample(s): All acceptance criteria were met.
  - Duplicate Sample(s): D. All acceptance criteria were met.
  - Lab Control Sample(s): E. All acceptance criteria were met.
  - F. Other: Observation of a Lab Control made for Color Analysis produced a value of 10 color units for a standard of 20 color units.
- lv. Documentation Exceptions: None.

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Linger Cothus 5-30.97 Liler Van Vicie 5/30/97 Reviewed by:

Project Manager Sampled By: Sampling Date Sampling lime: Type: Matrix:	e: Yw97		Laboratory IC Date Rec's Analytical Metho Date Analyzed Report Revision No	d: <b>5/23/9</b> 7 b.: 0 y: H. Van <b>Nice</b>
Client Sample ID	Lab Scimple ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
<b>Verncor Filtrate</b> <b>Zeeweed</b> Permeate	538301 538302	5 5	S U . S	Color Units Color Units

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Applied Sciences Laboratory Corvalits Office

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2300 NW Walnut Blvd., Corvallis. OR 97330-3538 P.O. Zax 428, Corvallis. OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

# CH2MIHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

[1] LMQ. 2567 Fablane Drive Monigomary, AL 38116-1622
 (334) 271-1444 FAX (334) 271-3428

 I IRD
 6090 Catarpiliar Road
 I ILIW Canvico Analytical Laboratories, Inc.
 I I GV0 2300 NW Walnut Bo

 Redding, CA 96003 1412
 50 Balturst, Unit 12, Waterloo, Ontario, Canada N2V 2C5
 Corvuls, OR 87/330 3638

 (916) 244-5227
 FAX (918) 244 4109
 (519) 747-2575
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Client Information Project Name Project Manage Sampled By Sampling Date sampling Time Type Matrix:	r: City of McAllen r: Rosie Villarreal r: E. Perez r: 5/29/97	Laboratory	Laboratory ID Date Rec's Analytical Metho Date Analyze Report Revision No	d: EPA 110.2 d: 5/30/97 o.: 0 y: H. Van Nice
Client Sample ID	Lab Sample ID	Reporting Limit	Color (ALPHA) Apparent Result	Units
Feedwater	541601	5	5 U	Color Units

Applied Sciences Laboratory Corvallis Office

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2300 NW Wainut Bival. Corvallis. OR 973x-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

## Corvallis Applied Sciences Laboratory

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Client_Inferentie	Lab Information
Project Name: City of McAllen	Laboratory ID: ICROR001
Project Manager: Rosie Villarreal	Date Rec'd: 5/30/97
Sampled By: E. Perez	Analytical Method: SM5310.D
Sampling Date: 5/29/97	Date Analyzed: 6/2/97
Sampling lime: 9:00	Report Revision No.: 0
Type: Grab	Reported By: G. Collins
Matrix: Water	Reviewed By:
Basis As received	Units: mg/L

Client Sample ID	<b>Lab</b> Sample ID	рH	<b>Reporting</b> Limit	Replicate 1	<b>TOC</b> Water Replicate	2	Average	Percent RPD
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U=Not detected at sp	ecified detection	limits						

Applied Sciences Laboratory2300 NW Walnut Blvd., Corvallis, OR 97330-3538Corvallis OfficeP.O. Box 428, Corvallis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

## MONTHLY BILLING SUMMARY

CH2MHILL Applied Sciences Laboratory Corvailis, Oregon 2300 NW Walmut Biva. Corvailis, OR 97330-3538 P.O. Bax 428, Corvailis, OR 97339-0428 541 m-277 Fax 541 752-0275

City Of McAllen Project Manager: Jim Geisbush/PHX

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Invoice Date 05/27/97 Invoice No. A97-0910

Page 1 Of 1

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	ustomer Number		CHW Hill Rep. Ginger Collins	Billing <b>Peri</b> 6/11/97		ence No. 1383
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• <b>2</b> 2	Color (ALPHA) A Total Organic <b>Ca</b>	Apparent I <b>DON</b>		5/23/97 5/23/97	320.00 <b>\$40.00</b>	\$40.00 \$80.00
	(THIS	IS NOT A BILL -DO	NOT SUBMIT PAYMENT,	TOTAL A	MOUNT:	\$120.00

Our records indicate that the above tests were requested during me current billing period. Please notify the laboratory listed above if mere are any discrepancies.





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CH2M HILL 2300 NW Wainut Blvd. Corvalis, CR 97330-3538 Mailing acdress: P.O. Box 428 Corvalis, OR 97339-0428 Tel 541.752.4271 Fex 541.752.0276

## 5/27/97

City of McAllen

Subject: Acknowledgment of sample set 5383.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/23/97. It has been assigned laboratory number 5383. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Ver Mattick

Jerri Mattick

Attachment

# CH2MHIEL' Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

**14.008 2567 Feidene Drive** Monigameny, AL 36116-1622 (334) 271-1444 FAX (334) 271-3426

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 Convince
 Analytical Laboratories, Inc.

 Redding, CA (6003:1412
 60 Bathursi, Unit 12, Waterico, Ontario, Canada N2V 2C6
 6918) 244-5227
 FAX (916) 244-4108
 (619) 747-2575
 FAX (519) 747-3808

GV0 2300 HW Walnut Boulevard Corvallis, OR 97330 3630 (541) 752-1271 FAX (541) 752-0276

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CH2M HILL 2300 NW Walrast Sive. Corvatis, OR 97330-3538 Mailing address: P.O. Box 428 Corvatis, OR 97339-0428 Tel 541.752.4271 Fex 541.752.0276

05/21/97

City of McAllen

Subject: Acknowledgment of sample set 5357.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/20/97. It has been assigned laboratory number 5357. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Jew Martick

Jerri Mattick

Attachment

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APP-202

# CH2MINIL Analylical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CI LNG 2567 Fairlane Drive Montgomery, AL 38118-1622 (334) 271-1444 FAX (334) 271-3428

 LRD
 Booev Chiefphiar Road
 LKW Canvico Analytical Laboratories, Inc.

 Rodding, CA 84003-1412
 50 Bashurel, Unit 12, Waterloo, Onlario, Canada N2V 2C5 (318) 244-5227; FAX (918) 244-4109
 (519) 747-2575

I. ICVD 2300 NW Walnut Boulevard Corvaliis, OR 97330-3638 (541) 752-4271 FAX (541) 752-0276

COC # Purchase Order # Project # Requested Analytical Method # THIS AREA FOR LAB USE ONLY 351511227 Lab # Paga ٥Í ..... т 2 HAAFP 5 45 1.1-13 Project Name HARE ġ انی. انگاران . . Minllen Pilot HAA വ് **Custody Review** . Å Q**Company Name** Millen Public 1.4.1 Project Manager or Contact & Phone # ities 4 LIMS Verification HMFP. LogIn ۵ 9 Report Copy to: THMFP ò THMF ROSIE VILLALASE õ F ō 0 0 N I.m Geisbush there nix <u>Pequested Completion Date:</u> | Site ID N οH Custody Seals Y N Bampie Disposai: Diagon Ice. Dur (Y/N WWTPH 2 ASAP Preservative Ň QC Level 1 2 3 Other Туре Matrix Ä H254 W S A A O I T I A C Q O H M A P B Cooler Temperature Sempling CLIENT SAMPLE ID LAB ξ ł (9 CHARACTERS) OC F 2 Alterna le Description Lab ID Date Time ( p 1 ~ TER MA (114/17) 10:10 D WAT ٤ ~ ۱ £ 203 5/19/57 19:51 9 0 WA Τ ç н ٤ ۶. 111/1 19:49 Mç **Indot** 5/11/2 15:42 ., لم っ V 5/11/57 122:13 Emply Bollies Date/Time **Emply Bollies** Date/Time **Received By** 5 5/14/47 ଜ 10:30 am. 112 5/4/67 11:30 milalle 1 aura (Please sign and print name) Dala/Time Relinguished By  $\overline{}$ Date/Time (Please sign and print name) 10:45 forez. 5 114/47 **u** 1 newin Pelez (Please sign and prime name) Date/fime av. Retingulaned By Date/Time (Please sign and prive name) ñ S MA THAT PAGEL V. 11:30 an lland 5119 DOSIC VILLAND IN INSTERNATION (PRESENT) (Pieses sign and punk name) Date/Time 3.44 Shipped Via Shipping # UPS FACER Other Contact & Carger



CH2M HRL. 2300 NW Walnut Blvd. Corvalis. OR 97330-3538 Mailing address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0278

May 19, 1997

City of McAllen

138067.A0.ZZ

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RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5293

### Jim Geisbush/PHX

On May 9.1997. the CH2M HILL Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and **associated quality** control data are enclosed. Any **unusual** difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal. we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P. O. Bax 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

## CH2M HILL Applied Science Laboratory Reference No. 5293

CVO Sample ID	Client Sample 🔟	Date collected	Time Collected
529301	Memcor Filtrate	05/08/1997	9:05
529302	Zeeweed Permeate	05/08/1997	9:05

· _

### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5293

### Client/Project: City of McAllen

- I. <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. <u>Analysis</u>:
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - B. <u>Blanks</u>: All acceptance criteria were met.
  - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- Iv. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

uner Collens lin Van Thie Prepared by: Reviewed by:

Project Manager. Sampled By Sampling Date: Sampling -rune: Type: Matrix:	: cii of <b>McAllen</b> Joe Ibarra Jr. : E. Perez : 5/8/97	Laboratory	Lab Info Laboratory IC Date Rec'd Analytical Method Date Analyzed Report Revision No Reported B Reviewed B	b: ICROR001 1: 5/9/97 1: EPA '110.2 1: 5/9/97 1: 0 1: 0 1: Van Nice
<u>Client Sample ID</u> Memcor Fitrate Zeeweed Permeate	Lab Sample ID 529301 529302	Reporting Limit	Color (ALPHA) Apparent Result 10 15	 Color Units Color Units
<u>u<u></u><b>≖Not detected</b> at s</u>	pecified detection lin	nits		

Applied Sciences Laboratory, ¹ Corvallis Office

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boratory. 2300 NW Walnut Blvd., Corvallis. OR 97330-3538 P.O. Box 428. Corvallis. OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

Project Manager: Sampled By: Sampling Date: Sampling Time Type: Matrix:	E. Perez 5/8/97	n			E Analytic Date Report Re Re	L a oratory ID: I ate Rec'd: { al Method: { Analyzed: { vision No.: ( ported By: viewed By: ( Units: )	5/9/97 5/9/97 5/9/97 0 G. Collins 576-
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Applied Sciences Laboratory-Carvallis Office •

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2300 NW Watnut Blvd., Corvailis, OR 97330-3538 P.O. Bax 428, Corvailis, OR 97339-0428 (541) 7524271 Fax No.(541) 752-0276 CH2IMHILL Analylical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

i ILMG 2567 Faktana Drive Moxigoriary, AL 36116-1622 (334) 271-1444 - FAX (334) 271-3428

i ILRID 5090 Calappillar Road Redding, CA 98003-1412 (918) 244-5227 FAX (918) 244-4109 (519) 747-2575 FAX (519) 747-3806

I IGV0 2300 NW Wakes dockerard Corvalis, OR 97330-3636 (541) 752 4271 FAX (541) 752 0276

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DISTRIBUTION Original - LAB Vellow - LAB Pink - Clie

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## MONTHLY BILLING SUMMARY .



**Applied Sciences Laboratory** 

CH2MHILL Corvallis, Oregon 2300 NW Walnut Bivd, Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Pmject Manager: Jim Geisbush/PHX

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Invoice Date 05/1 2/97 Invoice No. A97-0833

Page 1 of 1

	ustomer Number 38067.A0.ZZ		CH2M Hill Rep. Ginger Collins	Billing <b>Pel</b> 5/14/9		ference No. 5293
Qty		Description		Trans, Date	Unit Cost	Subtotal
$\frac{2}{2}$	Color (ALPHA) App Total Organic Carbo	parent on		5/9/97 5/9/97	\$20.00 \$40.00	540.00 850.00
	(THIS I	S NOT A BILL-DO N	NOT SUBMIT PAYMENT,	) TOTAL	AMOUNT:	\$120.00

Our records indicate that the above tests were requested during me current billing period. Please notify the laboratory listed above ii there are any diicies.

## - PROJECT COPY -

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CH2M HILL 2300 NW Wainut Blvd. Corvaliis. OR 97330-3538 Mailing address: P.O. Box 428 Corvaliis. OR 97339-0428 Tel 541.752,4271 Fax 541.752,0276 a

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May 13, 1997

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City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5244

### Jim Geisbush/PHX

On May 2.1997, the **CH2M HILL Corvallis** Applied Sciences Laboratory received three samples **with** a request for analysis of selected parameters.

The **analytical** results and associated quality control data are enclosed. Any **unusual difficulties encountered** during the analysis of **your samples** are discussed in **the** case **narrative**.

Under **CH2M HILL** policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M** HILL Applied Sciences **Laboratory** appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you **need** additional **information**, **please** call Ms. Kathy McKinley at (541) **758**-0235, extension 3120.

Sincerely,

Ullu Frances

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences L	zboratory	•	1
Corvallis Office	•		

2300 NW Wainut Blvd., Corvallis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5244

CVO Sampie ID	Client Sample ID	Date Coilected	Time Collected
524401	Feedwater	05/01/1997	
524402	Memcor Filtrate	05/01/1997	
52443	Zeeweed Permeate	05/01/1997	

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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5244

### Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. Digestion Exceptions: None
- III. Analysis:
  - A <u>Calibration</u>: All acceptance criteria were met
  - B. <u>Blanks</u>: All acceptance criteria were met
  - C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.

. .

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Hillen Van Nice</u> DATE: <u>5-12-97</u> Reviewed by: <u>Hillen Van Nice</u> DATE: <u>5/12/97</u>

Corvallis Appl Client Information Project Name: ( Project Manager: Sampled By: Sampling Date: Sampling Time: N Type: Matrix: Basis: /	<b>City of McAllen</b> Joe I <b>barra</b> Jr. E. Perez 5/1/97 Not <b>provided</b> Gab	Laboratory	Date R& Analytical Meth Date Analyz Report Revision I Reported	ID: ICROR001 &d: 5/2/97 od: EPA1102 ed: 5/2/97
<b>Client</b> Sample ID	Lab <b>Sample ID</b>	Reporling Limit	Color (ALPHA) Apparent Result	Units
Feedwater Memcor Filtrate Zeeweed Permeate	524401 524402 524403		23 17 10	Color Units Color Units Color Units

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvaliis, OR 97330-3538 Convertie Office P.O. Box 428, Corvaliis, OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

## **Corvallis Applied Sciences Laboratory**

Client Sample ID	lab Comple ID	рНа	Reporting Limit	TC Replicate1 F	OC Water		Fercent RPD
Type: Grab <b>Matrix: Water</b> Basis: <b>As</b> received				Reviewed By: units: mg/L			
Sampling Time: Not provided				Report Revision No.: 0 Reported By: 3. Collins			
Sampling Date: 5/1/97				Date Analyzed: 5/9/97			
Sampled By: E. Perez				Analytical Method: SMs310.D			
Project Manager. Joe Ibarra Jr.				Date Rec'd: 5/2/97			
Project Name: Cii of McAllen				Laboratory ID: ICROR001			
lient Information							

Client Sample ID		pn	Limit	Replicater	Replicatez	Average	RPD	
Feedwater	524401	<2	0.80	8.5	8.4	8.4	12	
Memcor Filtrate	524402	2	0.50	8.1	8.1	8.1	0.0	
Zeeweed Permeate	524403	<2	0.50	8.0	8.1	8.1	1.2	

U≈Not detected at specified detection limits

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Applied Sciences Laboratory

2300 NW Walnut Blvd., Corvallis, OR 9733C-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

-

# CH2MIHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LNO 2567 Faktane Drive Monigomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

 LTLR0
 5090
 Caterpiliar
 Road
 LTLNW
 Carviro Analysical Laboratorilas; Inc.

 Rodding, CA 98003-1412
 50
 Balhural, Unit 12, Waterloo, Ontario, Canada N2V 2C5

 (916) 244-5227
 FAX (918) 244-4109
 (518) 747-2575
 FAX (519) 747-3806

LTCVD 2300 NW Walnut Boulevard Corvalius, OR 97330-3638 (541) 752-4271 FAX (541) 752-0278

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# MONTHLY BILLING SUMMARY

Applied Sciences Laboratory

CH2MHILL Cowallis, Oregon 2300 NW Walnut Blvd. Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0275

City of McAllen Project Manager: Jim Geisbush/PHX

Invoice Date 05/05/97 Invoice No. A97-0791

Page 1 of 1

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-	ustomer Number   <b>38067.A0.ZZ</b>	CH2M Hill Rep. Ginger Collins	Billing Pe 5/14/9		erence No. 5244
Qty	De	SCHPHON	Trans. Date	Unit Cost	Subtotal
3 3	Color (ALPHA) Asparent Total Organic Carbon		5/2/97 l 5/2/97	\$20.001 \$40.00	
	(THIS IS NOT A L	BILL - DO NOT SUBMIT PAYMENT)	TOTAL	AMOUNT:	3160.00

Our records indicate that Me above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

### - PROJECT COPY -



CH2M HILL 2300 NW Wainut Bivd Corvaliis. OR 97330-3538 Mailing address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.4271 Fex 541.752.0275

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05/13/97

City of McAllen

Subject Acknowledgment of sample set 5309.

#### Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/13/97. It has been assigned laboratory number 5309. Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problem noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Jew. Mattak

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Jerri Mattick

Attachment

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FAR Vallaur, FAR DINE, Client



CH2M HILL 2300 NW Walnut Blvd Corvatiis, OR 97330-3538 Mailing address: P.O. Box 428 Corvatiis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0275

05/12/97

City of McAllen

Subject Acknowledgment of sample set 5293.

Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/9/97. It has been assigned laboratory number 5293. Please refer to the laboratory number if you need m inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Ven Martick

Jerri Mattick

Attachment

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CH2IMHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

 LNG
 2567 Faktane Drive
 LRD
 5000 Caterpillar Road
 LKW Carrylo Analytical Laboratories, Inc.

 Monigomery, AL 36118-1622
 Redding, CA 95003-1412
 50 Ballwaret, Unit 12, Waterloo, Onlario, Canada N2V 2C5

 (334) 271-1444
 FAX (334) 271-3428
 (916) 244-5227
 FAX (918) 244-4109
 (519) 747-2575
 FAX (519) 747-3806

CI CVD 2300 NW Walnut Boulevard Corvallis, OR 97330-3638 (541) 752-4271 FAX (541) 752-0276

COC #

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Special Feedwater Analysis for Mentec Cleaning Solution Optimization

May 7.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5261 Jim Geisbush/PHX

On May 6, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed Any unusual difficulties encountered during the analysis of your samples are discussed in the case namative.

Under **CH2M** HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

sincerely,

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvatiis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvalis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

### CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5261

CVO Sample ID	Client Sample ID	Date <b>Collected</b>	Time <b>Collected</b>
526101	FEEDWATER	05/05/1997	8:20

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#### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5261

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#### Client/Project: City of McAllen

- L Holding Time: Holdind time for pH was exceeded when sample was received in the lab.
- II. <u>Digestion Exceptions</u>: None
- III. <u>Analysis</u>:
  - A. <u>Calibration</u>: All acceptance criteria were met
  - B. <u>Blanks</u>: All acceptance criteria were met.
  - C. <u>Matrix Spike Sample(s)</u>: Not applicable for Alkalinity. Reagent were not available for spiking Silica.
  - D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
  - E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
  - F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:

Reviewed by:

#### CASE NARRATIVE METALS

Lab Reference No.: 5261

#### Client/Project: City of McAllen

- L <u>Holding Time:</u> Au acceptance criteria were met
- II. Digestion Exceptions: None
- III. Analysis:

_

- A. <u>Calibration:</u> All acceptance criteria were met
- B. <u>Blanks:</u> All acceptance criteria were met.
- C. ICP Interference Check Sample: Au acceptance criteria were met.
- D. <u>Spike Sample(s)</u>: All acceptance criteria were met.
- E. <u>Duplicate Sample(s)</u>: Duplicate criteria (+/- 20 RPD) were not met for Iron (92.9 RPD). As reported, tile sample contained 37.3 µg/L Fe, while the sample duplicate contained 102 µg/L Fe.
- F. <u>Laboratory Control Sample(s)</u>: All acceptance criteria were met.
- G. <u>ICP Serial Dilution:</u> Not Required.
- H. <u>Other</u>. None
- IV. <u>Documentation Exceptions</u>: None

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V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: _____

Reviewed by: _____



CH2M HILL 2300 NW Walnut Blvd. Corvalis. OR 97330-3538 Matting address: P.O. Box 428 Corvalis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0275

May 7.1997

City of McAllen

138067.A0.ZZ

RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5261 Jii Geisbush/PHX

On May 6, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received one sample with a request for analysis of selected parameters.

The analytical **results** and associated quality control data **are** enclosed. Any unusual **difficulties** encountered **during** the analysis of **your** samples **are discussed** in the case **narrative**.

Under **CH2M** HILL policy, your samples will **be** stored for 30 days after **reporting**. If you have not given **us** prior **instructions** for disposal we will contact you if any samples require disposal as hazardous waste.

The **CH2M HILL** Applied Sciences Laboratory appreciates your business and looks forward to serving **your** analytical needs again If you should have any **questions** concerning **the** data, or if yon need additional information, please **call** Ms. Kathy **McKinley** at (541) **758**-0235, extension 3120.

Sincerely,

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE

CH2M HILL Applied Science Laboratory Reference No. 5261

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
526101	FEEDWATER	05/05/1997	8:20

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#### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5261

#### Client/Project: City of McAllen

- L Holding Time: Holding time for pH was exceeded when sample was received in the Lab.
- II. <u>Digestion Exceptions</u>: None

#### III. <u>Analysis</u>

- A. <u>Calibration</u>: All acceptance criteria were **met**
- B. Blanks: All acceptance criteria were met.
- c . <u>Matrix Spike Sample(s)</u>: Not applicable for Alkalinity. Reagents were not available for spiking Silica.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. Lab Control Sample(s): All acceptance criteria were met.
- F. <u>Other</u>: Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: <u>Lelen Van Nice</u> Reviewed by: <u>Litter Schone</u>

#### CASE NARRATIVE METALS

Lab Reference No.: 5261

Ξ.,

#### Client/Project: City of McAllen

- I. <u>Holding lime:</u> All acceptance criteria were met.
- II. Digestion Exceptions: None
- III. <u>Analysis:</u>
  - A. <u>Calibration</u>: All acceptance criteria were met.
  - B. Blanks: An acceptance criteria were met.
  - C. <u>ICP Interference Check Sample:</u> An acceptance criteria were met.
  - D. <u>Spike Sample(s)</u>: All acceptance criteria were met.
  - E. Duplicate Sample(s): Duplicate criteria (+/- 20 RPD) were not met for Iron (929 RPD). As reported, the sample contained 37.3 µg/L Fe, while the sample duplicate contained 102 µg/L Fe.
  - F. <u>Laboratory Control Sample(s)</u>: All acceptance criteria were met.
  - G. <u>ICP Serial Dilution:</u> Not Requited
  - H. <u>Other</u>. None

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- N. Documentation Exceptions: None
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL. both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by: Reviewed by:

<u>Client Informat</u> Project Mana Sampled I Client Sample Sampling Da Sampling lin Type Mat	Lab Information Date Rec'd: 5/6/97 Lab ID: 526101 Report Revision No.: 0 Reported By: G. Collins Reviewed By:					
Analyte	sis: As Received Reporting Limit	Sample Result	Qualifier	Units	Method	Date Analyzed
Chemistry						
Alkalinity	0.5	130		mg/L	EPA 310.1	5/6/97
pH Reactive Silica	0.4	7.1 20.0		mg/L mg/L	SM 2340.B SM4500Si-D	5/6/97 5/6/97
	•••					6.60
Metals	10.1	10.1		_ #		
Aluminum, ICP Calcium, ICP	42.1 49.1	42.1 111.000	U	µg/L µg/L	EPA 200.7 EPA 200.7	56'97 5/6/97
iron, ICP	17.6	37.3		µg/L	EPA 200.7 EPA 200.7	5/6/97

U=Not detected at specified reporting limits

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Applied Sciences Laboratory

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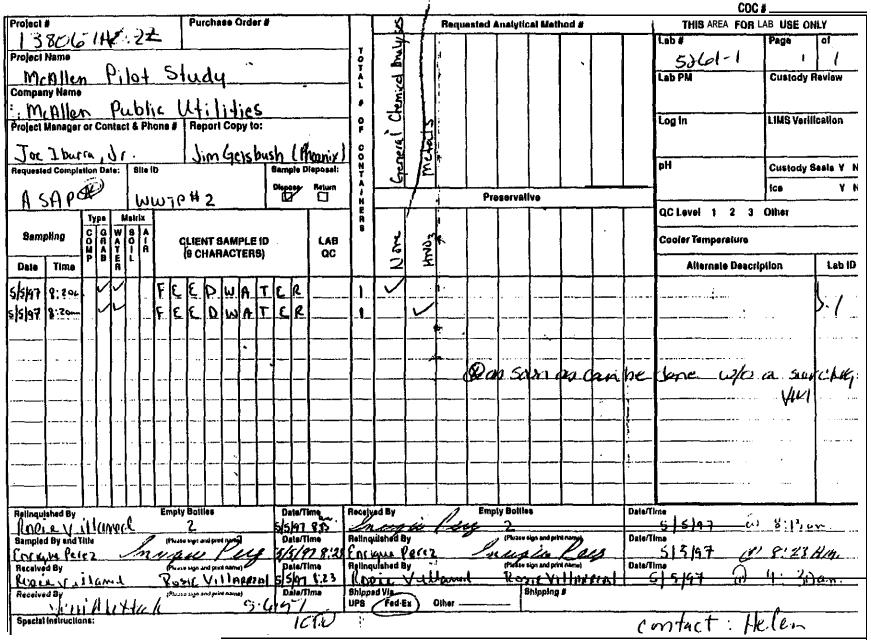
2300 NW Walnut Blvd., Corvatlis, OR 97330-3538 P.O. Bax 428, Corvatlis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276 τ-· ·

CH2MIHLL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

LANG 2567 Faktane Orive Monigomery, AL 38116-1822 (334) 271-1444 FAX (334) 271-3428 LRD 5090 Gelerpiller Road Redding, CA 96003-1412 (916) 244-5227 FAX (918) 244-4109

LKW Carwiro Analysical Laboratorisa, Inc. 50 Baltureti, Unit 12, Waterloo, Ontario, Canada N2V 2C5 (519) 747-2575 FAX (519) 747-3806

F76V0 2300 NW Walnut Boulevard Corvallis, OR 97330-3638 (541) 752-4271 FAX (541) 752 0276



DISTRIBUTION OF JUST LAD VOISSE LAR DISK CHIANT

# MONTHLY BILLING SUMMARY

Applied Sciences Laboratory

CH2MHILL Corvallis, Oregon 2300 NW Wainut Blvd, Convallis, OR 97330-3538 P.O. Box 428, Convallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City Of McAllen Project Manager: Jim Geisbush/PHX

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Page 1 of 1

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z = '

	ustomer Number 1 <b>38067.A0.ZZ</b>	CH2M Hill Rep. Helen VanNice	Billing Per 5/14/9		erence No. 6261
Qty	Descri	0100	Trans. Date	Unit Cost	Subtotal
1 1 1 1	Aluminum by ICP. Alkalinity Calcium by ICP. Iron by ICP.		5/6/97 5/6/97 5/6/97 5/6/97	\$10.00 \$20.00 \$10.00 \$10.00	\$10.00 \$20.00 \$10.00 \$10.00
1 1	Silica-Reactive		5/6/97 5/6/97	\$25.00 \$10.00	\$25.00
	(THIS IS NOT A BILL	-DOT NOT SUBMIT PAYMENT	) TOTAL	AMOUNT:	\$85.00

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

- PROJECT COPY -

**APP-232** 



CH2M HRLL 2300 NW Warnut Blvd. Corvelis: OR 97330-3538 Making address: P.O. Box 428 Corvatis: OR 97339-0428 Tel 541.752.4271 Fex 541.752.0276 ø

**.**...

5/7/97

City of McAllen

Subject: Acknowledgment of sample set 5261.

#### Dear Jim Geisbush/PHX:

This letter is m acknowledge the receipt of your sample set on 5/6/97. It has been assigned laboramry number 5261. Please refer m the laboramry number if you need m inquire about this sample set. I have attached a copy of the chain of custody form m provide additional information.

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free m call 541/758-0235 extension 3 117.

Sincerely, CH2M HILL

Sen Martick

Jerri Mattick

Attachment

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# CH2MHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

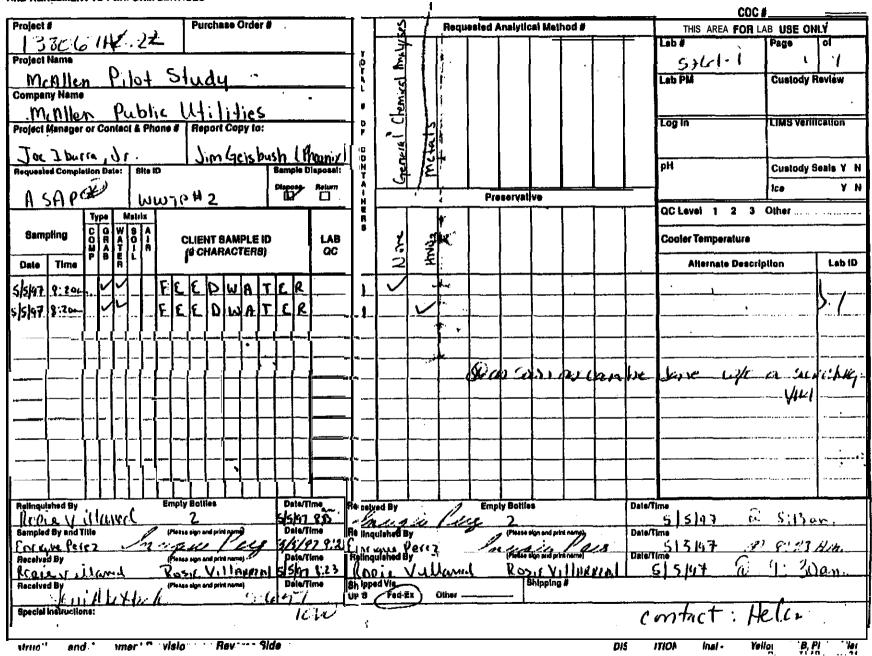
LING. 2567 Faktane Drivs Monigomery, AL. 36116-1622 (334) 271-1444 FAX (334) 271-3426

 LRD
 6090 Cateipilkar Road
 LKW Carviro Analytical Laboratories, Inc.

 Redding, CA 96003-1412
 50 Baltwrit, Unit 12, Waterico, Ontario, Canada N2V 2C5

 (916) 244-5227
 FAX (916) 244-4109
 (519) 747-2576

LICV0 2300 NW Walnut Boulevard Corvalla, OR 97330-3638 (541) 752-4271 FAX (541) 752-0278





CH2M HILL 2300 NW Wahut Elva. Corvallis, OR 97330-3538 Mailing accress: P.O. Box 428 Corvallis, OR 97339-0428 Tel 541,752.4271 Fax 541,752.0276

#### 05/05/97

City of McAllen

Subject Acknowledgment of sample set 5244.

#### Dear Jim Geisbush/PHX:

This letter is to acknowledge the receipt of your sample set on 5/2/97. It has been assigned laboratory number 5244. Please refer m the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

. .

There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

Ven Wastak

Jerri Mattick

Attachment

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# CH2IMHILL Analytical Services CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

**11MB 2567 Fairlane Drive** Montgomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

LRD 5000 Calephiar Road Redding, CA 98003-1412 50 Bathurel, Link 12, Waterloo, Ontario, Canada N2V 2C5 (918) 244-5227 FAX (918) 244-4109 (519) 747-2576 FAX (519) 747-3806

Covalia, OR 97330-3638 (541) 752-4271 FAX (541) 752-0276

Purchase Order # Project # ⁴ Requested Analytical Method # THIS AREA FOR LAD USE ONLY R.67.HQ22 Lab # <u>()</u> Page of 5244-1-12 T **Project Name** Ô. Ť McAllen p. Lab PM Jot **Custody Review** A **Company Name** ie S minllen .p olog 1000 clo 10C LIMS Verification Log in ۵ Project Manager or Conjaci & Phone # **Report Copy to:** JOH Ō c Jas in Grisbush ( Thania Ima ŏ e J pH й Custody Seals Y N Semple Disposal: Requested Completion Date: Sile ID fielum ice Y N Dieperse a S.A. P. WWTP # 2 Preservative ÷ Ň . OC Level 1 2 3 Other . . . . . . Type Mairix â H2504 C G W S A O R A O I M A T I N P B E L 2 として E. Ś Sampling える CLIENT SAMPLE ID LAÐ **Cooler Temperature** С H2 (9 CHARACTERS) QC. e ō Ê -Leb ID 2 Alternate Description Time Date 1 1.141 2 ..... Feed walter ۱ \$1.11 ¥i Membra 2  $\mathbf{v}$ Shhi И 111640 7 Mko Filiki ١ Islihi cui 2 ~ Perma-6/1/27 24 ঠ 2 benered Permeate ~ ١ sh 141 **Empty Bottles** Date/Time Emply Bottles Date/Time **Received By Relinguished By** â 0147 17 : In Jacob **6**. ĥ (Piesso sign and print name) Date/Time Relinguished By (Please plan and print name) Date/Time Sappled By and Tilla Heimquisted By 5/1/92 Kern Janie FNILCH 5/1/07 9:45 (Prese and prive rand) . Rathan Trevenu DATAVENTIO Date/Thme Received By Kamon Trevino TNI 5/1/1710. R 11:15 Am 10 47 10 Shipped Vis Shipping # Date/Time (Please sign and print name) **Received By** Other 12 in the second 141*21*1 64 043. Special Instructions: , ь 1 1111 6...

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DIS ITION inal -Yello 8, Pi. lent



CH2M HILL 2300 NW Walnut Elvo. Corvallis, OR 97330-3538 Mailing address: P.O. Box 428 Corvallis, OR 97339-0428 Tel 541.752.4271 Fax 541.752,0276

April 30, 1997

City of McAllen

138067.A0.ZZ

Analytical Data for **City** of **McAllen** RE: CVO Laboratory Reference No. 5213

#### Jii Geisbush/PHX

On April 25, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if my samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley a! (541) 7% 0235, extension 3120.

Sincerely,

allufnew

Kelly Ensor Senior Administrative Assistant

Enclosures

Corvalis Office

Applied Sciences Laboratory . 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P. O. Box 428, Corvallis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

## CLIENT SAMPLE CROSS-REFERENCE '

CH2M HILL Applied Science Laboratory Reference No. 5213

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
521301	Memcor Filtrate	04/24/1997	
521302	Zeeweed Permeate	04/24/1997	

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#### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5213

Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None

#### m. Analysis:

- A. <u>Calibration:</u> All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met
- E. <u>Other</u>: Not applicable.
- Iv. Documentation Exceptions: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

unger ( 1/1115 DATE: 4-29-97 Lin Van Nice DATE: 4/29/47 Prepared by: Reviewed by: 7

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Corvallis Appl	ied Science	es La	aboratory			-	
							:
Client Information						Lab Informa	
	City of McAller	ו				poratory ID: 1	
Project Manager:						Date Rec'd: 4	
Sampled By: Sampling Date:						al Method: 3	
Sampling Date.						evision No.: (	
	Grab					eported By:	
	Water				Re	eviewed By:	y le
Basis:	As received					Units: I	mg/L
L							
	Lab		Reporting		TOC Water		Percent
Client Sample ID	Sample ID	pН	Limit	<b>Replicate 1</b>	Replicate 2	Average	RPD
Memcor Filtrate	521301	<2	0.50	7.6	7.6	7.6	0.0
Zeeweed Permeate	521302	<2	0.50	7.4	7.4	7.4	0.0
	•						
U=Not detected at s	pecified detection	าก โเกาปีร					
U=HOL UELEULEU AL S							<u></u>

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Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P.O. Box 428, Corvallis, OR 97339-0428

-

(541) 752-4271 Fax No.(541) 752-0276

Project Manager sampled By: Sampling Date: Sampling Time Type: Matrix	: City of McAllen : Joe <b>Ibarra</b> Jr. E. Perez 4/24/97	Laboratory	Lab Information Laboratory ID: ICROF.00 Date R&d: 4/25/97 Analytical Method: EPA 1'10.2 Date Analyzed: 4/25/97 Report Revision No.: 0 Reported By: H. Van Nic Reviewed By: Gmc.					
<u>Ciient Sample ID</u>	Lab <b>Sample</b> ID	Reporting <b>Limit</b>	Color (ALPHA) Apparent <b>Result</b>	Units				
Memcor Filtrate Zeeweed Permeate	521301 521302 pecified detection lim		57	Color Units Color Unik				

Applied Sciences Laboratory, · Corvalis Office

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2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276 ----

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H2M Hill Project # Purchase Order #				LAB TES				BHADED ARE	- FOR LAB USE ONLY
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MLINED POL Study								Quote #	Kit Request 4
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Isticited By & Tills place sign and print name) MILL C. C. C. C. C. C. C. C. C. C. C. C. C.	Date/Time <i>4-94, 97 9</i> Date/Time	Con Reling	ulehed By	Heres sign and prin	<u>gue l</u>	lever	Date/Tir 4/- 24- Date/Tir	979'10 00 m	A
Lecolved By Key Will Porter	4/14/197_9:10 Balantina S-17 1.2	2 Ine Relling	ie Villar ulehed By	A.4 (Plazas sign and priv		VILLEREZA	4/29/9 Date/Tir		MARTIN ION SALE
Received By (Please eign and print name)	Date/Time	Shippi	d Via EUS Fod	Ex) Hand	Olher	Shippir	g #		
York Authorized By (Please sign and print name)	Remarke		<u> </u>	<u> </u>			· · · ·	what c	

/instructions ...d Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow L..., Pink - Client TEV 3/P+ FORM 340

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APP-242

# MONTHLY BILLING SUMMARY



city of McAllen Project Manager: Jim Geisbush/PHX

.

Invoice Date 04/25/97 invoice No. A97-0764

Page 'I of 1

-	ustomer Number	Billing <b>Period</b>		Referenc <b>ce No.</b>	
	I <b>38067.A0.ZZ</b>	5/14/97		521 <b>3</b>	
Qty	Description		Trans. Date	Unit Cost	Subtotal
2	Color (ALPHA) Apparent		4/25/97	320.00	\$40.00
2	Total Organic Cart-on		4/25/97	940.00	\$80.00
	(THIS IS NOT A BILL -DO	TOTAL	AMOUNT:	\$120.00	

Our records indicate that the above tests were requested during me current billing period. Please notify the laboratory listed above if there are any discrepancies.

• - PROJECT COPY -

# MONTHLY BILLING SUMMARY



Applied Sciences Laboratory

CH2MHILL Corvallis, Oregon 2300 NW Wainut Blvd, Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax 541 752-0276

City of McAllen Project Manager: Jim Geisbust/PHX

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Invoice Date ()4/21/97 Invoice No. A97-0710

Page 1 of 1

	ustomer Number 1 <b>38067.A</b> 0.ZZ	CH2M Hill Rep. Ginger Collins	Billing Per 5/14/9		erence No. 5182
Qty	Description		Trans. Date	Unit Cost	\$ubtotal
3	Color (ALPHA) Apparent		4/18/97	\$20.00	\$60.00
3	Total Organic Carbon		4/18/97	\$40.00	\$120.00
	(THIS IS NOT A BILL - DO	TOTAL	AMOUNT:	\$180.00	

Our records indicate that the above tests were requested during the current billing period. Please notify the laboratory listed above if there are any discrepancies.

### - PROJECT COPY -



CH2M HILL 2300 NW Walnut Blvd. Concattis. OR 97330-3538 Maiting accress: P.O. Box 428 Convatis. OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276 ŧ

April 30.1997

City of McAllen

138067.A0.ZZ

- RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5182
- Iii Geisbush/PHX

On April 18, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The **analytical results** and associated **quality control** data **are** enclosed Any **unusual difficulties encountered** during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy; your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

allerfrance

Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 Corvallis Office P. O. Box 428, Corvallis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276

## CLIENTSAMPLE CROSS-REFERENCE .

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cvo Sample ID	Client Sample ID	Date Collected	Time Collected	
518201	Feed Water	04/17/1997	11:00	
518202	Memcor Filtrate	04/17/1997	11:00	
518203	Zeeweed Permeate	04/17/1997	11:00	

## CH2M HILL Applied Science Laboratory Reference No. 5182

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#### **CASE** NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5182

÷.,

#### Client/Project: City of McAllen

- I. <u>Holding Time:</u> All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None

#### III. <u>Analysis</u>:

- A. <u>Calibration:</u> All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
- F. <u>Other</u>: Not applicable.
- IV. Documentation Exceptions: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been anthorized by the Laboratory Manager or his designee, as verified by the following signature.

tinger Collins DATE: 4-29-97 en Van Nice DATE: 4/29/97 Prepared by: Reviewed by:

Corvailis Appl Client Information Project Name: Project Manager Sampled By: Sampling Date: Sampling lime: Type: Matrix: Basis:	boratory		Analyt Dat Report F	Lab Inform aboratory ID: Date Rec'd: ical Method: ical Method: e Analyzed: Revision No.: Reported By: eviewed By: units:	ICROR001 4/18/97 SM5310.D 4/28/97 0 -G Collins		
Client Sample ID	Lab Sample ID	рH	Reporting Limit	Replicate 1	TOC Water Replicate 2	Average	Percent RPD
Feed water Memcor Filtrate Zeeweed Permeate	518201 518202 518203	2 2 2	. <b>0.50</b> 0.50 <b>0.50</b>	8.1 7.8 7.7	8.3 7.8 7.6	8.2 7.8 7.7	<b>2 4</b> 0.0 <b>1.3</b>

Corvallis Office

Applied Sciences Laboratory 2300 NW Walnut Blvd., Corvallis, OR 97330-3538 P.O. Box 428, Corvallis, OR 97339-0428 P.O. Box 428, Corvallis. OR 97339-0428

(541) 752-4271 Fax No.(541) 752-0276

Memcor Filtrate 518202 0 Color Units	Corvailis Applied Sciences Laboratory         Client Information       Laboratory         Project Name: City of McAllen       Laboratory ID: ICRO         Project Manager: Joe Ibarra Jr.       Date Rec'd: 4/18/9         sampled By: R. Villanal       Analytical Method: EPA         Sampling Date: 4/17/97       Date Analyzed: 4/18/9         Sampling Time: 11:00       Report Revision No.: 0         Type: Grab       Reported By: H. Var         Matrix: water       Reviewed By: grade         Basis: As received       Sampling Date: 4/18/9						
Memcor Filtrate 518202 0 Color Units	Client Sample ID				Units		
U=Not detected at specified detection limits	Memcor Filtrate Zeeweed Permeate	<b>518202</b> 513203		0	color Unik Color Units Color Unik		

Applied Sciences Laboratory . Corvallis Office

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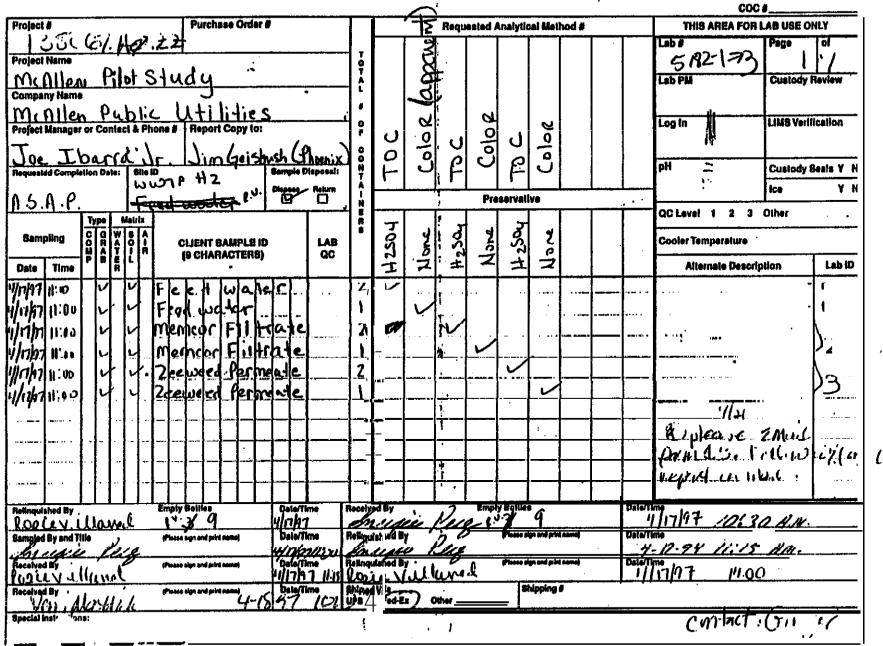
2300 NW Walnut Blvd., Corvallis, OR 973X.3538 P.O. Bax 428, Corvalis, OR 973394428



(] LMB 2567 Feidene Drive Montgomery, AL 36116-1622 (334) 271-1444 FAX (334) 271-3428

LRD 5090 Caterpillar Road Redding, CA 98003-1412 (910) 244-5227; FAX (916) 244-4109 (519) 747-2575 FAX (519) 747-3806

Circle 2300 NW Walnut Boulevard Corvallis, OR 97330-3638 (541) 752-4271 FAX (541) 752-0278





CH2M HILL Anslytical Services 2300 NW Watnut Blvc Corvalis, OR 97330-3538 P.O. Box 428 Corvalis, OR 97339-0428 Tel 541.752.4271 Fax 541.752.0276

04/21/97

City of McAllen

Subject: Acknowledgment of sample set 5182

Dear Jim Geisbush/PHX:

This letter is to acknowledge tie receipt of your sample set on 4/18/97. It has been assigned laboratory number 5182 Please refer to the laboratory number if you need to inquire about this sample set. I have attached a copy of the chain of custody form to provide additional information.

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APA 24 1997

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There were no problems noted with the receipt of your samples

If you need assistance, please. feel free to call 541/758-0235 extension 3 117.

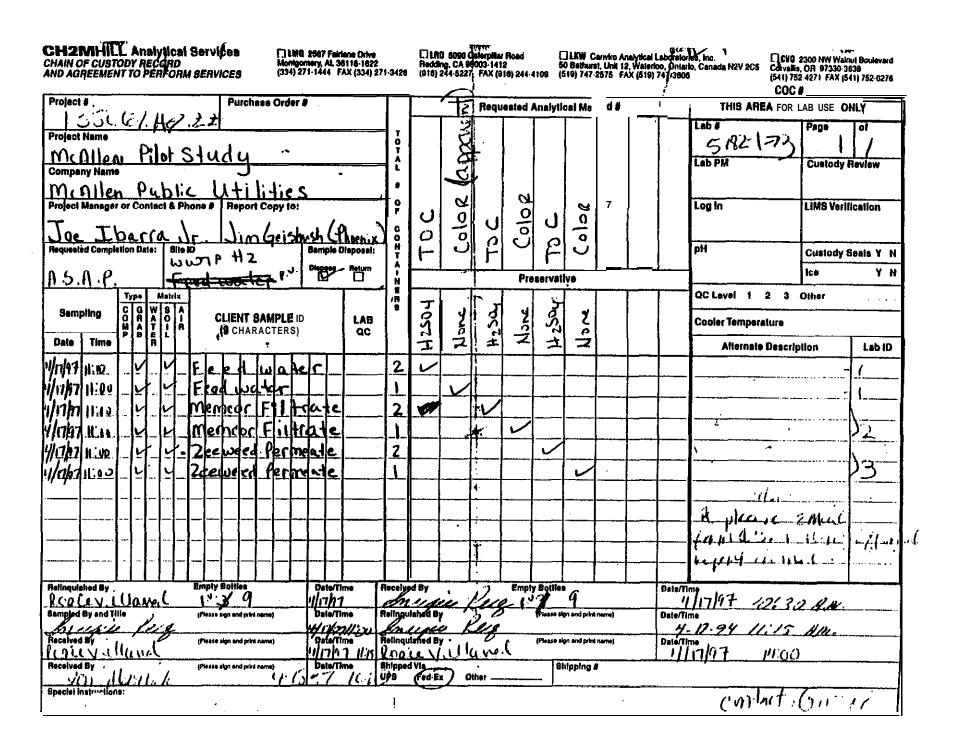
Sincerely, CH2M HILL

Jew Martick

Jerri Mattick

Attachment

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April 30, 1997

City of McAllen

### 138067.A0.ZZ

### RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5182

### Jim Geisbush/PHX

On April 18, 1997, the CH2M HILL Corvallis Applied Sciences Laboratory received three samples with a request for analysis of selected parameters.

The analytical results and associated quality **control** data are enclosed. Any unusual **difficulties** encountered during the analysis of your **samples are** discussed in the case narrative.

Under **CH2M HILL** policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples **require** disposal as hazardous waste.

The **CH2M HILL** Applied Sciences **Laboratory** appreciates your business and looks forward to serving your **analytical** needs again. **If** you should have **any** questions concerning the data, or if you need additional information, please **call** Ms. Kathy McKinley at (541) 7584235, extension 3 120.

Sincerely,

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Kelly Ensor Senior Administrative Assistant

Enclosures

Applied Sciences Laboratory Corvallis Office 2300 NW Walnut Blvd., Corvatiis, OR 97330-3538 P. O. Box 428. Corvatiis, OR 97339-0428 541 752-4271 Fax No. 541 752-0276 ---

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### CLIENT SAMPLE CROSS-REFERENCE

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cvo Sample ID Client Sample ID Date collected Time Collected

CH2M HILL Applied Science Laboratory Reference No. 5182

5182.01	Feed Water	04/17/1997	11:00
518202	Memcor Filtrate	04/17/1997	11:00
5 18203	Zeeweed Permeate	04/17/1997	11:00

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### CASE NARRATIVE GENERAL CHEMISTRY

Lab Reference No.: 5182

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### Client/Project: City of McAllen

- I. <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion</u> <u>Exceptions</u>: None

### III. Analysis:

- A. <u>Calibration</u>: All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- c . <u>Matrix Spike Sample(s)</u>: An acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. Lab Control Sample(s): All acceptance criteria were met.
- F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.

· · ·

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above, Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

 Prepared by:
 DATE:

 Reviewed by:
 DATE:

Project Manager: Sampled By: sampling Date: Sampling Time: Type: Matrix:	R. Viilanal 4/17/97		Laboratory Date Re Analytical Mett Date Analyz Report Revision	By: H. Van Nice
<b>Client</b> Sample ID	Lab <b>Sampie</b> ID	Reporting limit	color (ALPHA) Apparent <b>Result</b>	Units
Feed water Memcor Filtrate Zeeweed Permeate	<b>518201</b> 518202 518203		2.5 0 0	Color Units Color Units Color Units

Applied Sciences Laboratory

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2300 NW Watnut Blvd., Corvatlis, OR 97330-3538 P.O. Box 428, Corvatlis, OR 97339-0428 (541) 752-4271 Fax No.(541) 752-0276

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CH2M HILL Analytical Services 2300 NW Walnut Bird Corvalis. OR 97330-3538 P.O. Box 428 Corvatis, OR 97339-0428 Tel 541.752.4271 Fex 541.752.0276

4/28/97

City of McAllen

Subject: Acknowledgment of sample set 5213.

Dear Jii Geisbush/PHX:

This **letter** is to acknowledge the receipt of your sample set on **4/25/97**. It has been **assigned laboratory** number 5213. Please refer to the **laboratory** number **if** you need to inquire about this sample **set**. I have attached a copy of **the** chain of custody **form** to provide additional **information**.

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There were no problems noted with the receipt of your samples.

If you need assistance, please feel free to call 541/758-0235 extension 3117.

Sincerely, CH2M HILL

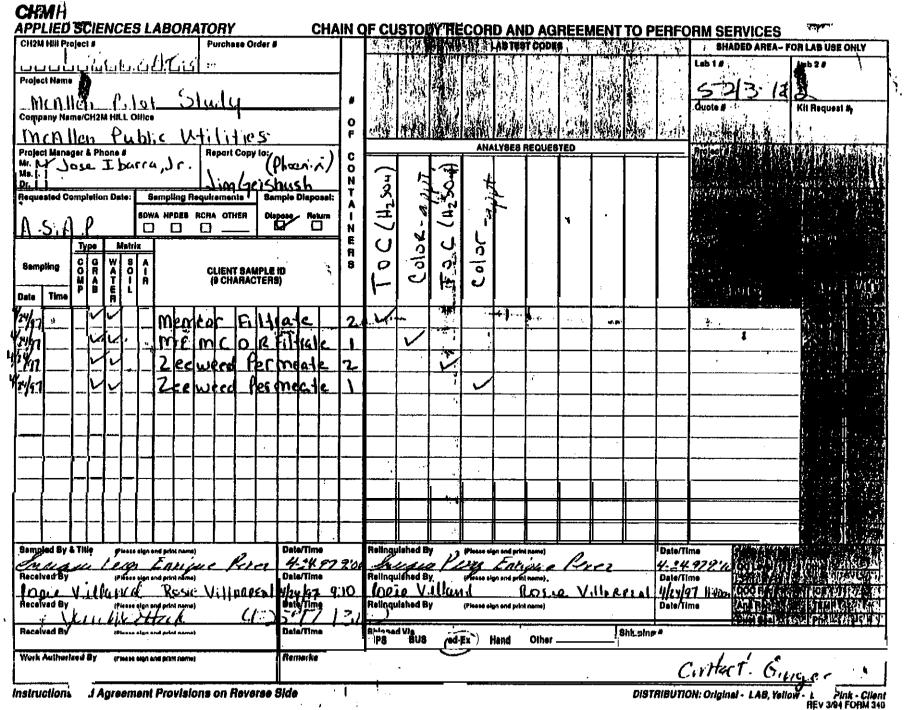
Jewi Macttack

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Jerri Mattick

Attachment



APP-258

April 30, 1997

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City of McAllen

138067.A0.ZZ

#### RE: Analytical Data for City of McAllen CVO Laboratory Reference No. 5213

### Jim Geisbush/PHX

On April 25.1997, the CH2M HILL Corvallis Applied Sciences Laboratory received two samples with a request for analysis of selected parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of your samples are discussed in the case narrative.

Under CH2M HILL policy, your samples will be stored for 30 days after reporting. If you have not given us prior instructions for disposal, we will contact you if any samples require disposal as hazardous waste.

The CH2M HILL Applied Sciences Laboratory appreciates your business and looks forward to serving your analytical needs again. If you should have any questions concerning the data, or if you need additional information, please call Ms. Kathy McKinley at (541) 758-0235, extension 3120.

Sincerely,

Wenter

Kelly Ensor Senior Administrative Assistant

Enclosures

Laboratory Corvallis Office

Applied Sciences 2300 NW Walnut Blvd., Corvatilis, OR 97330-3538 P. O. Box 428. Corvatlis, OR 97339-0428

541 752-4271 Fax No. 541 752-0276

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# CLIENT SAMPLE CROSS-REFERENCE

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CH2M HILL Applied Science Laboratory Reference No. 5213

CVO Sample ID	Client Sample ID	Date Collected	Time Collected
521301	Memcor Filtrate	04/24/1997	
521302	Zeeweed Permeate	04/24/1997	

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### CASE NARRATIVE

GENERAL-Y

### Lab Reference No.: 5213

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### Client/Project: City of McAllen

- L. <u>Holding Time</u>: All acceptance criteria were met.
- II. <u>Digestion Exceptions</u>: None
- III. Analysis:

-

- A. <u>Calibration</u>: All acceptance criteria were met.
- B. <u>Blanks</u>: All acceptance criteria were met.
- C. <u>Matrix Spike Sample(s)</u>: All acceptance criteria were met.
- D. <u>Duplicate Sample(s)</u>: All acceptance criteria were met.
- E. <u>Lab Control Sample(s)</u>: All acceptance criteria were met.
- F. <u>Other</u>. Not applicable.
- IV. <u>Documentation Exceptions</u>: None.
- V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

Prepared by:	DATE:	_
Reviewed by:	DATE:	_

# Corvallis Applied Sciences Laboratory

Project Manage sampled By Sampling Date: Sampling lime: Type Matrix	e: Cii of <b>McAllen</b> r Joe <b>Ibarra</b> Jr. y: E. Perez		Date Rec Analytical Metho Date Analyze Report Revision No	d: 4/25/97 b.: 0 ly: H. Van Nice
<b>Client</b> Sample ID	Lab Sample <b>ID</b>	Reporting Limit	Color (ALPHA) Apparent <b>Result</b>	Units
Memcor Filtrate Zeeweed Permeate	521301 521302		<b>5</b> 7	Color units Color units

U=Not detected at specified detection limits

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Appendix D. MF System Cleaning Procedures

### ZeeWeed Cleaning Procedures (Prior to Phase II Operations)

1. A water flux was **performed** membranes.

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- 2. The **ZeeWeed** process tank was flushed **three** times **with** plant service water.
- 3. A clean water flux was performed on the membranes.
- 4. The process tank was emptied and the clean-in-place tank (CIP) was filled with a 200 ppm sodium hypochlorite (NaOCI) solution which was then backwashed through the membranes. This was repeated twice.
- 5. The **process** tank was filled with plant service water and a clean water flux was **performed** on the membranes.
- 6. Step 4 (empty tank cleaningwith sodium hypochlorite) was repeated
- 7. A clean water flux was performed on the membranes.
- 8. The process tank was filled with plant **service** water and sodium hypochlorite to yield! a **200** ppm solution, and the membranes were allowed to soak **overnight** with the sprayer pump on and the blower on at **8** SCFM.
- 9. The process tank was flushed with plant service water.
- 10. The process tank was filled **with** plant service water and a clean water flux was **performed** on the membranes.
- 11. A bubble test was performed on the system

## ZeeWeed/ZenoGem System Cleaning and Decommissioning Procedures

- 1. A water flux was performed with the modules in standard operating conditions.
- 2. The process tank was emptied and the clean-in-place tank (UP) was **filled** with a 200 ppm sodium hypochlorite solution made from clean tap water and the membrane was back pulsed with the solution until the membranes were fully wetted outside the lumen. The solution was allowed to so* on the surface of the lumen for 20 minutes.
- 3. Step 2 was repeated.
- 4. A clean water flux was performed.
- 5. The sodium hypochlorite solution was carefully and completely washed out of the **CIP** tank with clean tap water.
- 6. A solution of MC-1 was added to the **CIP** tank to produce a **pH** of 2 and the membranes were backpulsed with the **solution** as **in Step** 3.
- 7. A clean water flux was performed.
- a. After the cleaning tests were done, a **Zenon** representative was contacted to discuss the cleaning results.
- 9. The membranes were preserved with a 60% by volume glycerin solution containing 05% by weight of sodium **metabisulfite** provided by **Zenon.** The solution was placed in the **CIP** tank and the membranes were backwashed with the solution until the membranes were fully wetted on the outside of the lumen.
- 10. The system was preserved with the 60% glycerin solution
- 11. The unit was **re-created** and shipped back to **Zenon.**

# Memcor MF System Final Cleaning and Decommissioning Procedures

- 1. The membranes were cleaned using a 2% citiric acid soludtion, followed by a 2% mixture of Memclean EXA. This is the same procedure as for all of the other cleanings during the study.
- 2 The system was operated for 5 minutes in the service mode using a 1% Memclean EXA solution.
- 3. The **sytem** was **complety** drained using the drain down cycle and the **strainer** was cleaned to remove loose **particles** and replaced.
- 4. the exterioor of the unit was cleaned with a mild soapy solution.
- 5. The **MF** unit was place in the original **crate** for return to the manufacturer along with the Material Safety Data Sheet and the CMF **Return** Check **List**.
- 6. All **additioanl** equipment associated with the system was cleaned and packed in its **orignal crates** for shipment

Move the following to the appendix

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REPORT D	Form Approved MB No. 0704-0188			
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4. TITLE AND SUBTITLE			5. FUNDIN	G NUMBERS
Wastewater Reclamation Pilot Study				
6. AUTHOR(S)			<u> </u>	
Jim C. Lozier				
7. PERFORMING ORGANIZATION NAM	ME(S) AND ADDRESS(ES)			MING ORGANIZATION
			REPORT N	eport No. 26
CH2M Hill 9. SPONSORING/MONITORING AGEN	CY NAME(S) AND ADDRESS/ES)			
Bureau of Reclamation				EPORT NUMBER
Water Resources Research Laborat	ory			
Technical Service Center				
Denver, Colorado				
11. SUPPLEMENTARY NOTES				
TI. SUFFLEMENTART NOTED				
12a. DISTRIBUTION/AVAILABILITY ST	ATEMENT		12b. DISTR	RIBUTION CODE
13. ABSTRACT (Maximum 200 words)				
The study evaluated the capability of the	Memcor microfiltration (MF) membra	ane technolog	y and the ZeeWeed MF men	torane technology to treat
wastewater for indirect potable reuse to				
ZenoGem process. The ZenoGem process is	designed to biologically treat screened, de	-gritted sewage	and microfilter the "secondary ef	fluent."
Both Memcor and ZeeWeed are applica	ble to the advanced treatment of City	of McAllen wa	astewater for the purpose of	indirect potable reuse.
The Memcor MF process can efficiently	treat secondary effluent from the Mc/	Allen South W	WTP. ZeeWeed MF techno	logy is competitive with
Memory MF technology in the production	n of RO feedwater from secondary ef	fluent when no	n-economic factors are con	sidered. ZeeWeed is a
versatile water reuse technology that ca	n microfilter secondary effluent and c	anty activated	i siudge to qualmes sunable	for use as NO feedwater.
ZenoGem can treat McAlien's raw waste	ewater to a quality comparable to the	City's existing	WWTP effluent more efficie	ntly than the existing WWTP.
It is anticipated that a ZenoGem/RO sys	tom would be loss evenensive to cons	third and one	ate than the combination of i	conventional secondary
wastewater treatment, Memcor or ZeeV	Veed MF, and RO.			
14. SUBJECT TERMS				15. NUMBER OF PAGES
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